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SCIENTIFIC AND TECHNICAL LITERATURE AND INFORMATION

THE incidence of hostilities has already brought in its train considerable dislocation in the various activities that are concerned with the provision of literature and information. In the world of science and technology this dislocation may seriously affect the national effort unless its implications are rapidly appreciated and appropriate readjustments made. To the disturbance that, as in the War of 1914–18, resulted from interference with the supply of foreign literature and from the diversion of money and labour into activities apparently more necessary than the provision of information, the present conflict has added the distraction caused by air-raid precautions. In consequence of these latter, many institutions have ceased their activities, or transferred them to locations relatively remote from centres of storage and distribution of information.

A re-orientation of scientific and technical investigation is essential in war-time. To a certain extent research based on careful analysis of previous work must yield place to intensive experimentation devoted to the rapid solution of urgent problems, and to enhanced productivity along well-established lines, involving observation and testing rather than co-ordination and deduction.

There is still a case to be made out for research of the more fundamental type, divorced from considerations of purely war-time expediency, just as there is a case strongly supported for the provision of intellectually satisfying literature and art. But the present review is more concerned with the provision of literature and information specifically germane to the war demands.

Of outstanding importance in this connexion is the supply of current scientific and technical periodicals, both domestic and foreign. Second only to this factor of supply of literature is that of its distribution for individual consultation in accessible localities. Lastly, there is the problem of adaptation of the literature to meet specific needs, that is, the problem of co-ordinated information or documentation.

As regards the supply of scientific periodicals, there is no reason to anticipate interruption in the receipt of the publications of non-European countries. But there may be delays in receipts, and occasional lacunæ due to enemy action. Probably the only real trouble will be delay, since replacement of any issues actually lost will be fairly simple. In the case of supplies of European periodicals, especially those emanating from Germany, considerable reduction in the normal supplies must be anticipated, and replacements will be difficult, if not impossible. It is important, therefore, that such stocks as are received should be wisely allocated to storage and distribution centres, and that any copies received for purely temporary perusal should be conserved in case of need. A clearing-house for this section of literature is needed at the outset, to which surplus copies can be sent for conservation, and demands for filling gaps submitted. Something on the lines of the Smithsonian Institution service might perhaps serve the purpose.

In regard to distribution, it is obvious that more elasticity will be needed in consequence of the re-distribution of centres of research. Many provincial libraries will have abnormal calls upon them for literature, whereas many London libraries will experience a falling off in demand, especially for consultation on the spot. The necessity for lending will be augmented, and the risk of casual losses in transit enhanced; added to this risk,

there will be that of destruction of publications issued, due to enemy action or accident.

From the point of view of increased need for borrowing publications, it is satisfactory to know that the lending service of the Science Library, South Kensington, will be maintained, and augmented to any necessary degree. The situation is being carefully watched, and appropriate steps are to be taken to meet any increase in demand for these widely appreciated facilities. But it must be remembered that this library is situated in a fairly vulnerable area, and alternative supplies ought to be provided in case its own are dislocated. The National Central Library is still functioning as a clearing-house for demands for books on loan, but it relies very largely upon the Science Library for supplies of scientific and technical publications. Probably, in this respect, it is not so much necessary to create alternative central scientific lending libraries as to establish a system of co-ordination among the various provincial libraries, of the university and research types.

A union-catalogue of war-time holdings of important foreign (especially European) periodicals in such libraries as are willing to lend appears to be a necessary first step. This catalogue could very rapidly be compiled, and located at the proposed institution serving as a clearing-house for supplies.

Finally, there remains the problem of supplying information, that is, of documentation; this service naturally comprises the initial one of indexing or abstracting. So far as is known, the normal peace-time British abstracting services are continuing to function, and our workers can rely also upon a steady supply of abstracts, etc., from the United States. But these latter may be delayed and interrupted, and the importance of an acceleration in the tempo of abstracting must be emphasized. A review of the available machinery in Great Britain is obviously needed in the present circumstances. Perhaps, as the sequel, a better co-ordination will be secured and overlapping avoided; what is important, however, is that any gaps should be closed.

On the wider question of documentation, a warning against over-emphasis upon specialization is needed. British research services are rightly proud of their diversity and individuality. But with the threat of war-time economies, and the urgent need for increasing the speed of the survey of available literature on certain problems, there is grave danger of undesirable duplication. Moreover, it has always been a defect of system in Great Britain that undue attention is focused upon outstanding publications, whereas others are very largely neglected. This criticism applied particularly to publications in difficult languages. There is no excuse for neglecting such publications at a time when thousands of refugees, representing many different languages, are living in Great Britain and anxious to assist in any possible way the national effort.

Finally, the methods now in vogue for reconstituting published scientific and technical records into forms adapted to easy reference in relation to specific problems need to be improved. It has long been obvious that our present methods are largely a legacy from the last century, when records were much less numerous and activities less interdependent. Moreover, new techniques have been introduced, for example, into the business world, that are capable of adaptation with great resulting advantage into the field of scientific documentation. Hitherto their use in this field has been hesitating and half-hearted, and consequently their value has been diminished. A co-ordinated, large-scale adoption of modern methods is long overdue, and the present emergency suggests itself as providing the necessary inducement, for the reason that now the efforts of research workers, technologists and business *entrepreneurs* are directed to a specific task, and canalized in particular channels. Co-operation of endeavour and interchange of information are essential if the effort is to be a maximum.

To sum up: a central body is needed immediately to meet the conditions now obtaining in respect of the supply and use of current European scientific and technical periodicals. Its functions would be to record holdings of such publications in the various centres of research and libraries, and to maintain a service of spare issues for replacements in the various centres. It would also serve as a centre for lending via regional services outside London, and to co-ordinate information services and ensure adequate 'coverage' of the periodicals selected for attention. Any additional abstracting or digesting, translation or reproduction necessary might also come within its purview. Eventually it might be possible to cover non-European literature in addition, but the establishment of a central body for the limited purview suggested appears to be an urgent need. Lastly, it would act as a repository of information, and distribute appropriate extracts, epitomes or complete dossiers as needed.

THE BIOLOGY OF THE CELL SURFACE

The Biology of the Cell Surface
By Ernest Everett Just. Pp. xi+392. (London: The Technical Press, Ltd., 1939.) 26*s*. net.

DR. JUST has written an interesting account of his personal views on a group of subjects including fertilization, cell division, and the function of chromosomes. The first part of the book, dealing mainly with the structures, functions, and movements of the ectoplasm (the outer layers of the protoplasm) of marine eggs, contains a large amount of material on which there is fairly general agreement. The following chapter, on water, deals with the movements of water in eggs, and between eggs and their environment. It is stated that when eggs are placed in hypertonic saline, water leaves the egg in discrete droplets, which apparently have to pass through comparatively narrow channels in penetrating the ectoplasm. This extremely interesting observation, if confirmed, would invalidate the majority of the work which has been done on the permeability of marine eggs, in which it is assumed that water leaves the egg by simple diffusion. In the same chapter, Dr. Just betrays some doubt as to the existence of a relatively impermeable membrane at the surface of the cytoplasm. There is to-day no ambiguity on this point; the impedance studies of Cole (*J. Cell. Comp. Physiol.*, **1**, 1; 1932; *J. Gen. Physiol.*, **18**, 877; 1935) have shown that such typical eggs as those of Arbacia and Hipponoë have a membrane which is impermeable to ions, while Chambers (*Biol. Bull.*, 69, 331; 1935) has shown by microdissection that this membrane is liquid and fatty in character.

The account of fertilization and parthenogenesis is excellent and perhaps the most interesting part of the book. Dr. Just's objections to Loeb's 'superficial cytolysis correction' theory of parthenogenesis are justified by adequate experimental evidence; he presents an alternative view (p. 245): "The most important factor in all modes of initiating development is a dehydration process affecting directly or indirectly the ground substance" of the cytoplasm. With this statement there may be some measure of agreement, although ultra-violet light, which is an effective parthenogenetic agent with many eggs, and the prick with a needle which will initiate development in a frog egg, can scarcely be considered as dehydrating agents. This rebuttal of Loeb scarcely justifies, however, the following remarks (pp. 238–239):

"The history of biological research furnishes us with other examples which illustrate the shortcomings of such physico-chemical approach in the setting-up of a singly studied property of living matter as synonymous with the whole complex of life-processes. Witness the theories of oxidation, permeability, electrical conductivity, viscosity, and the like. . . . Or take the almost universal fashion in which Hill's work on nerve conduction was accepted. By 'proving' that a nerve conducts without heat-loss this work must lead logically to the conclusion that the nerve fibre is not living, since it gives no evidence of metabolism. Strictly orthodox morphologists have likewise often presented theories of life-processes on the basis of demonstrations that only emphasize anew the capacity of the living thing, though debased, to respond according to its specific and intrinsic irritability. The now perfect collapse of the organizator theory is a case in point."

The first sentence of this paragraph shows that Dr. Just is flogging a horse which is not only dead, but had never lived except in the minds of a few holding extreme views. Such remarks impair a book which is always interesting when dealing with the author's own experimental work, and their rather frequent occurrence may lead many to dismiss it at less than its true value.

Succeeding chapters on cell division and cleavage are of great interest. Much ingenious indirect evidence is quoted to show that cell division may be independent of nuclear division. It is regrettable that the excellent work of E. B. Harvey on parthenogenetic merogeny (*Biol. Bull.*, **71**, 101; 1936) is not once mentioned. Mrs. Harvey has shown that non-nucleated egg fragments of a number of species, for example, *Arbacia punctulata*, will develop, after parthenogenetic treatment, in a manner closely similar to that of the normal egg up to the stage of a blastula of about 500 cells. They do not, however, form free-swimming larvæ, and it seems highly probable that development beyond this stage is normally controlled by the nucleus. Thus the possibility of independent division of nuclei and of cytoplasm inferred by Dr. Just has, in fact, been directly observed.

The later chapters, dealing with chromosomes, etc., are almost entirely speculative. Some idea of the direction of these speculations may best be given by quotation:

"As development of the egg progresses [pp. 320-321], the egg potencies are restricted through their withdrawal from the cytoplasm by the chromosomes with each successive cell-division. Thus the cytoplasm forms functional areas. At some time in the history of the eggs' development, the potencies, having been previously taken out and

stored by the chromosomes during cleavage and succeeding stages of differentiation, escape into the cytoplasm. The cytoplasm of the fertilized or parthenogenetically developing egg restores them again to the chromosomes."

P. 328: "The active 'factors' for Mendelian characters do not reside in the genes; rather, the genes, by extracting definite materials from the cytoplasm, render possible the reaction of the cytoplasm-located hereditary factors. Only in so far as they take out substance do the genes determine heredity. Thus finally every cell in the most complex organism has in its nucleus all the potencies bound except that one which is free in the cytoplasm, and which makes the cell specific."

Dr. Just does a useful service in directing attention to the role of the cytoplasm, but it is to be feared that in his attempts to give important roles to the cytoplasm, he has abstracted more from the significance of the nucleus than is permissible.

J. F. Danielli.

PRAGMATICAL LOGIC

Logic

The Theory of Inquiry. By John Dewey. Pp. viii + 546. (London: George Allen and Unwin, Ltd., 1939.) 18*s*. net.

THIS book is the author's fourth on the subject, but only one other, "How We Think", is listed in the English Reference Catalogue. The present work is suited to more advanced students: it is discursive and controversial in manner, and Mr. Dewey's characteristic style will not encourage the puzzled beginner. It views logic—somewhat strenuously—as the study of the methods of solving problems.

Problems are all practical: "How to arrange things to suit us? What would suit us?" Evaluation and actual experiment are necessary for securing final judgment (pp. 160, 179). Final judgment has an actual subject and an ideal predicate (p. 124). Truth is defined by reference to ultimate agreement through certain methods of inquiry (p. 345). No actual judgment is incorrigible (p. 141): inquiry is continuous. Propositions are instruments for reaching judgments: they are defined by reference to symbols (pp. 51, 110). They include two fundamental sorts: existential, which express factual data, and non-existential, which define concepts (pp. 136, 283). The former are generated by the operations of selection-rejection, unifying-discriminating—which are the organic basis of 'is', 'is not', 'and', 'or' (p. 186). No existential proposition is ever universal: general existential (or 'generic') propositions, though expressed by 'all' or 'no', are not *A* or *E* propositions, since they assign only *observed* singulars to kinds (p. 380). Genuine universals are all definitive of kinds—that is, they exhibit possible substitutions within one system of symbols (pp. 300, 404). Such syntactical relations, however, are instituted on the basis of past discoveries: so that transformation from one expression to another (deduction) leads to inference, which is existential and probable. A chief aim of science is to institute a language that facilitates inferences. Mathematics is the free development of syntactical relations—the exhibition of language as a system (p. 394). Induction—gathering of evidence—proceeds under direction of hypotheses the implications of which are explored by deduction (p. 427). Universal propositions are used as causal laws in order to show the continuity of series of events: causation is not itself an ontological category (p. 458). A frequency theory is offered to justify the reliance we place in inductive-deductive methods (p. 470).

The inquiry begins as an empirical description of inquiries (a kind of directed behaviour). The rules of inquiry appear as contracts, demands to be satisfied (pp. 16, 406). The psychology of using symbols is described as the organic basis of logical functions (p. 186). But logic must not only describe, it must also justify, the methods of inquiry. Here I detect an ambiguity: we may *justify* a given rule by deriving it, according to certain principles, from more fundamental rules. Such justification is absolute: by it we distinguish valid arguments from merely persuasive arguments. It consists in exhibiting all valid procedures as one system unified by certain principles of consistency, identity, etc. This justification is provided by formal logic. But what justifies the system itself? Rationalists *justify* (in another sense) the laws of thought, by appeal to an 'inerrable faculty'. Pragmatists—rejecting 'supernatural' reason—seek a merely *practical justification* of inquiry. Their typical error is to try to justify particular principles without showing their place in one system. This ignores absolute, logistic justification altogether; and plainly we cannot complete a practical justification of any definition merely by reference to special interests and situations. For we must justify the rules that

govern the inter-relations of terms, that is, the formal rules and formal signs that bind a system together. This might be done by showing that unless terms have fixed meanings throughout one argument, the aims of inquiry cannot (causally) be achieved.

A painstaking reader will come to the conclusion that Mr. Dewey is highly successful in avoiding typical pragmatist errors. There are, however, certain hesitations which will excite the suspicious and disconcert the unwary. Does Mr. Dewey confuse formal and nonformal (p. 312), logical and psychological (pp. 106, 186)? Does he confuse the formal dilemma '*A* or *not-A*?' with the nonformal '*A* or *B*?' and so miss the fundamental importance of consistency (p. 346)? Does he understand necessary connexion (pp. 19, 44)? This last question is answered very satisfactorily indeed in Part 3—but doubt may survive until then.

Formalists will find many of their objections met if only they can be persuaded to read 546 pages of wordy and repetitious discourse. Pragmatists and logical positivists will welcome an able and comprehensive account of the views of one of the three or four founders of pragmatism.

KARL BRITTON.

SEISMIC PROSPECTING

Practical Seismology and Seismic Prospecting By Prof. L. D. Leet. (Century Earth Science Series.) Pp. x + 430 + 5 plates. (New York and London: D. Appleton-Century Co., Inc., 1938.) 25*s*. net.

BOTH from an academic and a commercial point of view, the exploration of the crust of the earth by explosion waves has assumed considerable importance in recent years. Of great geological interest, for example, are Prof. Ewing's seismic exploration of the continental shelf of the north-eastern part of the United States and Dr. Bullard's recent delineation of the Palæozoic floor of East Anglia, whilst on the industrial side seismic prospecting has been employed in the search for oil and in supplying data required in the construction of highways, bridges and dams. A treatise giving more than a mere outline of the technique is therefore of considerable interest, especially as actual surface strata by no means conform to the idealized uniform sheet usually depicted in works on seismology; it is all the more acceptable since it is written by a practical seismologist who is equally familiar with the geological, geophysical and technical aspects of the work.

The book is in five parts, with tables and appendixes; it has a large number of excellent illustrations and copious references. The kernel of the treatise consists of Part 2 (elasticity and elastic waves), Part 3 (instrumental methods) and Part 5 (seismic prospecting). Although the title of the work indicates a twofold purpose, workers in seismological observatories have been adequately catered for already, and the justification—a sufficient one—of the present volume is the dearth of easily accessible information on seismic prospecting.

Part 2 is of great interest. The first chapter (Chapter iii, on elastic constants) describes laboratory methods and gives valuable tables of elastic moduli of a large number of rocks as determined by modern experiments, including also the high-pressure determinations of Bridgman and others. Chapter iv, on the propagation of waves in surface strata, is very thorough, and is as clear an account of the subject as could be desired; two- and three-layer structures, with inclined interfaces, are treated, as likewise is Slichter's important work on layers in which wave velocity varies with the depth. Chapter v, on the paths and travel times of earthquake waves, completes Part 2, and is complementary to the two preceding chapters.

Part 3 consists of two long chapters. Instruments (Chapter vi) are given an adequate theoretical treatment, and the theory of the Benioff electromechanical transducer is included. One is disappointed to find so little about the seismographs used in prospecting, although to some extent this is explained by the secrecy maintained (probably needlessly) by commercial geophysical organizations concerning details of their apparatus. Chapter vii, on the instrumental observation of earthquakes, outlines the interpretation of records and summarizes the general conclusions that have been drawn concerning the interior of the earth; some of this work could scarcely be called 'practical seismology', but it is perhaps as well not to insist on too rigorous a distinction.

It is Part 5, to be read in conjunction with Part 2, that makes the most distinctive contribution to seismological literature. A fairly full account is given of the reduction of observations, in particular of the tracing of a salt-dome. Formulæ

are developed for dealing with reflexion shooting and for working up the results by the method of least squares; there is also some information on the reading of explosion records. The chapter on special commercial applications includes a table of patents on seismic prospecting taken out in the United States.

The great drawback of this book is its expense. The portion already outlined is just about all that the title of the volume demands, and for the practical student this content, occupying some 250 pages and costing perhaps 15*s*., would have been admirable. The author, however, wanders over so wide a field that the title is misleading. For example, he opens with a chapter on "Cause of Earthquakes", which is mainly an interesting but irrelevant summary of the geological history of North America; the long chapter on the distribution of earthquakes might well have been omitted. There are short chapters on terminology and the history of seismology, and substantial chapters on the effects of earthquakes, important earthquakes of history, and the mechanics of earthquake occurrence; all these are interesting enough in their proper setting, but quite out of place in a work of the scope indicated by its title. It would be a real help to the average student who has little to spend on text-books if this attractively written and well printed treatise could be reissued without Parts 1 and 4 and at about half its present price.

R. STONELEY.

PROF. STEPHEN TIMOSHENKO

Contributions to the Mechanics of Solids
Dedicated to Stephen Timoshenko by his Friends on the occasion of his Sixtieth Birthday Anniversary. Pp. viii + 277. (New York: The Macmillan Company, 1938.) 22*s*. net.

EMINENT scientific workers are frequently the recipients of special awards and public or professional honours, but it is rare to find the ceremony of presentation displaying these features that transformed the annual dinner of the Applied Mechanics Division of the American Society of Mechanical Engineers in December last, into a function wholly and variously devised to honour Prof. S. Timoshenko, who then completed his sixtieth year. The most impressive event in a programme of appreciative items and speeches was undoubtedly the presentation to Prof. Timoshenko of a commemorative volume to which twenty-nine engineers and men of science of international reputation contributed original papers. This volume has now been published and is a striking and unusual tribute to one who, on the subject range covered by the papers, is an outstanding authority. It is seldom that a teacher and investigator receives such a demonstration of regard while still actively engaged in his work; but the range and power of Prof. Timoshenko's studies, the importance of his contributions to scientific engineering and his great reputation as a teacher, have rightly won for him this notable and spontaneous tribute.

The brief outline of Prof. Timoshenko's career which prefaces the collection of papers is of great interest as showing the varied lines along which he has progressed to the position of a leading authority in the use of analytical methods on behalf of technical problems. While Timoshenko considers himself primarily a teacher and prefers the academic life, his work shows his direct concern with the practical issues of analytical processes; and even his most theoretical studies are enriched by a regard for the technical applications possible to the methods elucidated or derived. This is, of course, a natural outcome of the wide experience acquired in the tenure of important research and consulting positions in industry; and when such experience is allied to the exceptional analytical powers that have made him famous as the occupant of professorial chairs in Russia and America, the results are bound to be valuable and are rightly acclaimed. His publications make an impressive list comprising five books and twenty-three papers in Russian and ten books and forty-eight papers in English, French or German.

The twenty-nine papers in this commemorative volume cover a wide field in the subject of the mechanics of solids, and the topics treated are highly appropriate considering the aim and inspiration. The majority are on theoretical processes and applications of theory to stress analysis and vibration subjects, on which lines Timoshenko has written very extensively. Fatigue and creep of metals receive considerable attention, while special subjects like photo-electricity and friction are also represented. Mainly the authors are American friends and associates, but admirers

abroad are also well represented. Papers are included by Föppl, Prandtl, von Mises, Huber, Southwell and Taylor.

Such a book dedicated to such an authority should give a true reflection of modern methods and problems. In this it does not fail. Buckling and stability studies; critical conditions and complex vibration systems; studies in creep and plastic flow characteristics; on fatigue data and the mechanism of friction; on methods of analysis and calculation; on basic equations; in reviews of development, etc., are tackled with power and highly specialized knowledge. The range must be examined to be appreciated. It would be impossible even to detail the themes here, and to select a few for individual mention would be invidious and contrary to the spirit of the publication. The volume is a storehouse of advanced method and knowledge, and forms a fitting and graceful tribute to one who is universally acknowledged to be a leading exponent of the lines studied.

MEXICO: PRESENT AND PAST

(1) **An Eye-Witness of Mexico**
By R. H. K. Marett. Pp. xi + 268 + 8 plates. (London, New York and Toronto: Oxford University Press, 1939.) 8*s*. 6*d*. net.

(2) **Mexican Mosaic**
By Rodney Gallop. Pp. 300 + 48 plates. (London: Faber and Faber, Ltd., 1939.) 15*s*. net.

IN these two books, widely different aspects of Mexico are presented; but they should be read in conjunction, if it is desired to obtain a complete picture of what Mexico has become after four hundred years of contact with European civilization. The term 'contact' is used advisedly. Although it is a common assumption that the people of what is generally called Latin America are the heirs of Spanish, or more strictly Iberic culture, of most of them, at least so far as the general run of the populace is concerned, it would be more correct to say that their inheritance is fundamentally Indian, but with modifications by European tradition and forms of religious belief. This is certainly true of Mexico, perhaps above all the others; for, of the Mexican population one third is of pure Indian stock, and not more than one sixth is of unmixed white blood. Sixty different languages or dialects are still spoken within its borders and more than a million of the people have no Spanish. In the north, indigenous Indian tribes, Yaqui, Cora, Tarahumare and others, are virtually untouched by modern civilization.

(1) In this remarkably varied society, ranging from a comparatively advanced modern civilization to the primitive Indian, it is not surprising to find that there is much that is instructive for sociologist and anthropologist. Mr. Marett, as the author of a work on Mexican archæology, is fully alive to the claims of the past, but here he is concerned mainly with present-day tendencies, though he is able at times to add point to his argument by references to earlier history. He examines present trends in politics, thought and belief, development in social relations and above all in the competitive struggle now taking place between agrarianism and industrialization. In these matters his business experience in Mexico, extending over some years, as well as his social contacts through his marriage with a Mexican lady, enable him to speak with a double, and for a European, exceptional authority.

(2) Mr. Gallop, on the other hand, is not concerned with forward movement. His interests lie in the past, the survival in custom, belief, ritual and practice among the populace of much which in all essentials is not European, but Indian, handed down by tradition from the time of the Spanish conquest and probably from long before.

Mr. Gallop came to the study of the Mexican people with an intimate knowledge of the people and folk-lore of northern Spain, the Basques in particular, and therefore is well qualified for the task of disentangling the threads of Spanish influence from the Indian strands with which it is interwoven. On the religious processions, dances and feasts which form so large an element in popular practice, he is able to speak with especial confidence, as, for example, in his analysis of the cult of Our Lady of Guadeloup, in which he sees, with good reason, that it is essentially the ritual ceremonial of the Aztec goddess of fertility. From the various feasts and ceremonies which Mr. Gallop records, more especially the ritual battles and the survival of the Indian ball game, it is evident that the cult of fertility is no less prominent in the lives of the modern Mexicans, even if not always consciously, than it was among their ancestors.

THE CELL AND PROTOPLASM

SYMPOSIUM AT STANFORD UNIVERSITY

BY PROF. C. V. TAYLOR,
STANFORD UNIVERSITY, CALIFORNIA

THE Symposium on the "Cell and Protoplasm", which was convened at Stanford University, California, during June 30–July 5, began on the last evening of sessions of the Pacific Division of the American Association for the Advancement of Science and closed on the day of registration for the Sixteenth National Colloid Symposium. This time relation would partly account for the large attendance at the Cell Symposium, which increased with each session to an audience of about seven hundred at the closing lecture on "Structural Units" by Prof. J. D. Bernal, of the University of London.

The attendance and growing interest that marked this commemorative Symposium can be accredited primarily to the excellence of the papers presented —all by investigators of merited eminence. Their number included several distinguished biologists whose names have been familiar in the front ranks of biological science for more than a quarter of a century. Among the other participants were those whose more recent physical and chemical analyses of the cell and its protoplasmic constituents have greatly extended the confines of biological knowledge and have doubtless pointed the way for further productive researches of fundamental importance.

In all, thirteen American men of science participated, representing eleven universities and research institutes, and three visitors from Europe: Prof. A. Szent-Györgyi of Hungary, Prof. Hugo Theorell of Sweden and Prof. J. D. Bernal of Great Britain.

Of the papers presented, one each morning, afternoon and evening of the five-day session, the first three were concerned with early and modern concepts of the cell and protoplasm.

In the initial address on "An Historical Account of Cell and Protoplasm Concepts", Prof. E. G. Conklin of Princeton University re-emphasized the social nature of scientific discovery in which the end result of successive achievements of many minds is often given undue recognition. Thus credit for the formulation of the cell theory as commonly accorded to Schleiden and Schwann was believed unwarranted because their accounts had been antedated many years by the published results of various workers, beginning notably with Robert Hooke (1667).

The second paper, by Prof. Robert Chambers of New York University, on "The Micromanipulation of Living Cells", essentially resolved our modern concepts of the living cell as a protoplasmic unit to the unified nature and interrelations of its molecular constituents. As illustrated in a motion picture, the protein constituents of the living protoplasm tend to retain their integrated state in the presence of an engulfed droplet of oil, although upon cytolysis, induced through mechanical disruption of the nucleus or otherwise, a protein 'skin' forms and becomes wrinkled around the oil droplet. This film formation likewise ensues when such a droplet is added to a protein solution on a microscope slide. This integrated protein framework of living protoplasm, which may be demonstrated also by the air-driven ultracentrifuge, strongly indicates a multimolecular organization for the living cell.

Another modern aspect of protoplasmic constitution, gained chiefly through studies on protoplasmic elaborations, was presented in the third paper, by Prof. I. W. Bailey of Harvard University, on "The Cell Wall and Protoplasm". Clearly the structural nature of the cellulose wall laid down by the plant protoplasm should offer invaluable clues to the nature and spatial relations of the protoplasmic constituents. Hence, the regularity of a highly specific and characteristic structural pattern—whether concentric, radial, ramifying or radio-centric—of a given cell wall evidently reflects a potential pattern in the arrangement and orientation of the protoplasmic constituents from which the wall is derived. All evidence thus far indicates that the cellulose matrix of the cell walls of higher plants is a continuous rather than a discontinuous system of anastomosed chain-molecules the long axis of which is oriented parallel to the long axis of the cellulose fibril. They exhibit positive anisotropy and sharply defined extinction angles in monochromatic polarized light. At present, there is no reliable evidence that the structural framework of the cell wall is ever composed of any randomly oriented chain-molecules.

Complementing these three papers on the cell and protoplasm, there followed two on the cell and chromosomes. The first of these was given by Prof. H. S. Jennings of the Johns Hopkins

University on "Chromosomes and Cytoplasm in the Protozoa", and the second by Prof. Richard Goldschmidt of the University of California on "Genes and Chromosomes".

The well-known nuclear cycle that recurs with each cell division during the ontogeny of a multicellular organism was cited by Prof. Jennings as crucial evidence of material interchanges between the nucleus and cytoplasm. Accordingly, each condensed chromosome enlarges during the later phases of mitosis to become vesicular from material taken up from the cytoplasm. Within the resulting contiguous chromosome vesicles which constitute the reformed nucleus, the newly acquired cytoplasmic material is altered and, as such, is returned again to the surrounding cytoplasm upon the subsequent breakdown of the vesicular wall of each chromosome, the residue of which again condenses for the following mitosis. These cyclic interchanges and transformations apparently provide the essential mechanism of cellular differentiations both in the ontogeny of multicellular organisms and in the racial variations of these and of unicellular organisms. As illustrative of the latter, De Garis's recent results from crossing large and small races of Paramecium were discussed. These results showed that the ex-conjugants, having unlike cytoplasms but like nuclei, retained their size differences for about twenty-two generations, whereupon these differences gradually disappeared. Evidently, therefore, the two different cytoplasms were finally transformed by the like nuclei such that the two races of unequal size came to have the same size.

By what mechanism of the nucleus the cyclic modifications, and so racial differences, may be effected was discussed in the succeeding paper by Prof. Goldschmidt. His thesis tended to discount the commonly accepted gene theory of Mendelian heredity, and proposed instead a chromosome theory in which the occurrence of genes as discrete entities, arranged bead-like in a definite order, need not be assumed. Taking into account the similarities in chromosome form and structure in the cells of all organisms, wherein a visible fibril-like core may represent a single protein unit of definite stoichiometric properties along its axis, it would be more in accord with recent X-ray, chemical and polarimetric analyses to identify the chromosome as a chemical unit. Such a unit might show any amount of differential chemical complexity in different chain-molecules of similar length. This concept would ascribe to the chromosome a linear pattern and would account for mutational changes (the bar-effect, mosaicism, position-effect, etc.) as due to changes in the chromosomal pattern (inversions, translocations, duplication of parts, etc.) rather than to changes within discrete particles, or genes, of molecular order.

The demonstrable interrelations between cytoplasm and nucleus which would account for differentiation in both the individual and the race obviously represent but one of the two major components in the fundamental phenomena of living things. The other essential component is, of course, the environment. The role of environmental factors was well exemplified in the three papers that followed on developmental aspects of the cell and its relation to the organism. These included: "Cellular Differentiation and External Environment" by Prof. C. M. Child of the University of Chicago and Stanford University, "Cellular Differentiation and Internal Environment" by Prof. Ross G. Harrison of Yale University, and "Cell and Organism" by Prof. C. A. Kofoid of the University of California.

The external environment of the primordial cell, according to Prof. Child, is a determining factor in its differentiation at the very onset of development. The cell's primordial pattern is essentially a surface-interior pattern which reflects an intimate relationship with its environment. Also, by action of a suitable differential in its external environment, its polar or axiate differentiation is duly determined. Any one or more of various environmental differentials may induce this superimposed axiate pattern, as demonstrated, for example, in Whitaker's experimental studies on the ova of Fucus, as well as in numerous previous experiments by Prof. Child. Accordingly, the axiate pattern arises as a gradient which is initially quantitative in nature and which, once established, constitutes a gradient in rate of metabolic activity. Moreover, this environmentally induced axial or metabolic gradient then conditions the production and transfer of active constituents (chemical substances) in differentiating cells and so predetermines the course of later development.

Factors of differentiation in later stages of early development were discussed by Prof. Harrison as factors of the internal environment. These were illustrated especially from his extensive transplantation experiments on amphibian larvæ. Here the developmental pattern, which has progressed well beyond the initial axiate stage of Prof. Child's account, has demonstrably a primary cellular locus ('organizer') in the region of the dorsal lip of the blastopore and later various secondary loci, which determine organ differentiation throughout ensuing development. Depending upon the age of donor and of host as well as on the piece removed and its disposition where transplanted, the fate of the transplant and its effect upon the organogeny of the host were strikingly illustrated. From this it was evident that the fate and effect of a developing part are a function of its relation to other parts. This fundamental relationship obviously marks the internal environment of cellular differentiation.

In the succeeding paper, presented by Prof. Kofoid, it was emphasized, however, that even were the roles of both genetic and environmental factors of ontogenetic development well understood, that knowledge, essential as it must be, could constitute only part of any adequate understanding of the cell and organism. For the organism, beginning its individuality as a primordial cell, represents in its complete life-history not only the ontogeny that follows its unicellular stage but also the phylogeny preceding that stage. All organisms exhibit in this fundamental respect comparable life histories which may include, even for numerous so-called unicellular forms, a multicellular as well as a unicellular phase. Accordingly, it is only in terms of their total life-history, as an expression of their evolutionary and developmental history, that the cellular organization of living things can have basic significance and so the results of fundamental investigations a satisfactory basis of interpretation.

The two lectures that followed, one on "Chemical Aspects of Microorganisms" by Prof. C. B. van Niel of Stanford University, and the other on "The Structure of Viruses" by Dr. W. M. Stanley of the Rockefeller Institute, marked a transition from considerations of the cell and protoplasm of the more conspicuously cellular organisms to a discussion of the subcellular bacteria and of those ultramicroscopic, reproducing entities, the viruses, whose systematic status, whether animate or inanimate, apparently remains a problem of great moment.

Recognizing Schwann's important contribution not only to the formulation of the cell theory but also to the concept of yeast cells as vital agents of alcoholic fermentation, Prof. van Niel recounted the later developments of that concept, beginning especially with Pasteur, which have now led to a distinctly basic and far-reaching generalization. This generalization affirms that all chemical activities of living organisms are fundamentally hydrogen transfer reactions. Postulated first by Wieland for respiration as essentially a dehydrogenation of the respiratory substrate with oxygen or some other agent as the final hydrogen acceptor, this concept has become expanded by Kluyver and others to its present broadest generalization. Thus enzyme activity in metabolic processes serves primarily to facilitate hydrogen transfer reactions. It now appears that in the catabolic process this leads to the formation of products from which are directly synthesized the building stones of cell growth and differentiation by means of thermodynamically spontaneous reactions. This comprehensive generalization re-emphasizes the processes common to living things as the fundamental processes, the elucidation of which provides our point of departure for an adequate understanding of the more complex vital phenomena.

In this respect, the succeeding discussion on the viruses by Dr. Stanley was distinctly of fundamental significance. It now appears that these entities represent a margin of animate Nature beyond the limits of cellular organization as commonly understood, yet they exhibit properties of organic synthesis and reproduction characteristic of the living cell. Evidently their size relations alone are not definitive, since they are larger than some well-known microbes but several times smaller than some protein molecules. Their apparently complete dependence on a living cell for their reproduction would place them among obligate parasites the nutrient requirements of which are highly specific and, at present, beyond experimental duplication. Their essential nature, however, may have a counterpart in the chromosomal genes of the cell nucleus or in other known protoplasmic constituents such as the enzymes—a relationship which would obviously carry fundamental implications.

Some of the major advances in modern researches on the cell have had to do with its active protoplasmic constituents. Résumés of some recent results were presented on "Enzymes" by Prof. Hugo Theorell of the University of Stockholm, on "Plant Hormones", by Prof. F. W. Went, California Institute of Technology, and on "Vitamins" by Prof. A. Szent-Györgyi of the University of Szeged.

The common theme of these discussions demonstrated the essential relations between these several active constituents. The common role of enzymes in the formation or release of linkages within the carbon chain is referable initially to the prosthetic groups; and for a number of well-known enzymes, the vitamin nature of their active groups is now established. Thus, Prof. Theorell isolated the prosthetic group of the 'yellow enzymes' from the protein component by means of electrophoresis and identified this active group with vitamin B_2. It is now known also that vitamin B_1, including its pyrophosphate derivative, is identical with the prosthetic group of the enzyme carboxylase, and that the anti-pellagra vitamin is identical with the nicotinic acid amide, which is the essential part of the prosthetic group of various dehydrogenases.

Enzyme specificity, however, is evidently not due to the prosthetic group but to its associated protein molecule—thus denoting a relationship between activating and reacting components of the cell which may come to account fundamentally for all biological specificity. According to Prof. Went, therefore, the more generalized activity of the growth hormones can be attributed to their identity with prosthetic groups. This was well illustrated by the multiple effects of auxin in cell

elongation, bud inhibition, root formation and probably other functions inside the plant. The initiation of these growth processes, or their inhibition, is traceable to the effect of diffusing or free-moving auxin on the translocation of other essential growth factors. But the specificity of this effect is inherent in the co-growth factors of the reacting tissues. The production of these essential active groups by some cells, such as those of the growing tip of a coleoptile, and the transport of these groups to other cells of the plant, which through cellular differentiation have lost this producing capacity, afford an excellent illustration of the interdependence of cells and the functional integration of the various differentiated organs. These relationships obviously underlie a unity in the plant organism that is entirely comparable with that in the animal.

These considerations of enzymes and growth hormones clearly indicate the essential nature of the vitamins. As re-emphasized by Prof. Szent-Györgyi, vitamins may be identified with the prosthetic group of certain enzymes, and differ from a hormone chiefly through the accident of nomenclature, according to the source of production. Thus for rats or plants, ascorbic acid is not a vitamin since they themselves are able to synthesize it. In the same sense, thiamin is a vitamin for animals, a hormone in some plants and a vitamin for other plants, depending only on their powers of synthesis. Obviously these relationships give further evidence of the fundamental unity in the plant and animal kingdoms, and, in terms of the enzyme concept noted above, the vitamins constitute an important key to a better understanding of the essential nature of protoplasm and the cell.

The three concluding papers, as originally planned, effectively linked this Symposium with the National Colloid Symposium which directly followed. These included: "The Molecular Structure of Protoplasm" by Prof. O. L. Sponsler of the University of California at Los Angeles, "Protoplasm and Colloids" by Prof. L. V. Heilbrunn of the University of Pennsylvania, and "Structural Units" by Prof. J. D. Bernal of the University of London.

The general concept of the living cell as an organized protoplasmic unit, which was stressed in foregoing discussions, evidently presupposes for its protoplasm a fundamental architecture, that is, an integrated spatial arrangement of the protoplasmic constituents.

An analysis of this architecture was presented by Prof. Sponsler, as based on the known molecular constitution of protoplasm and computed from now fairly well-established dimensions of its protein chains and their linkages through hydrogen bonds. Assuming a degree of protoplasmic homogeneity, it was concluded that the protoplasm comprises parallel protein chains, of dimensions about 1000 A. by 10 A. by 4·5 A., which are laterally united by water hydration centres and which, in turn, compose a sponge-like framework intercalated with water containing the various solutes. From this elementary protoplasmic architecture is derived the fundamental pattern of the primordial cell which, through developmental differentiation, gives rise to the tissue cells and organs of the adult organism, as recounted in the earlier discussions.

The colloidal properties of protoplasm and its cellular differentiation were variously exemplified in the paper presented by Prof. Heilbrunn. His recent investigations have demonstrated especially a localization in the cortex of the cell of calcium which, upon appropriate stimulus, is released within and so effects a gelation of the protoplasm involving contraction. Further evidences of this gelating effect were found upon exposing cut surfaces of cells to various concentrations of calcium salts. Thereupon a reversible limiting membrane was formed on the cut surface, or a bulb-like contraction was locally induced, due to the penetrated calcium. Thus the age-old problem of contractility, a common property of protoplasm, may find its solution normally in the localization and release of calcium in the cell's cortex.

Recalling the emphasis given throughout the Symposium to the structural aspects of protoplasm, Prof. Bernal, in presenting the final paper, urged that consideration of the energy relations was equally important, since not only do the energies involved determine the sort of structure possible but also their nature must be known in order to account for that structure. These energies relate primarily to the protein constituents of the protoplasm, a model for which may be found in the tobacco mosaic virus when contained in known salt solutions. Here the virus entities, which are long protein molecules, become orientated in striking spindle-like patterns, or tactoids, and their regular distances apart vary directly with the concentration of the salt solution. Evidently long-range forces between the virus entities are operative through the ionic atmosphere of the surrounding medium with which the former are in equilibrium. The magnitude and direction of forces inside the tactoid pattern are different from those on the outside. These differences, in fact, account for the pattern formation. Apparently analogous forces may similarly account for the formation of the mitotic figure and the ensuing phenomena during the mitosis of the living cell.

These papers are soon to be published in book form by the American Association for the Advancement of Science.

THE RELATIVITY OF TIME

By Prof. Herbert Dingle,
Imperial College of Science and Technology, London

THE view is widely held that, according to the restricted theory of relativity, moving measuring rods are shortened in the direction of motion, and moving clocks run slow, in the ratio $\left(1-\frac{v^2}{c^2}\right)^{1/2}:1$, where v is the velocity of the rods and clocks relative to instruments otherwise identical but assumed to be at rest. This view is correct so far as measuring rods are concerned; but incorrect with respect to clocks.

No metaphysical significance is here implied with regard to length and time. The statement that a moving rod is shortened means that if an observer stands at the centre of a relatively stationary rigid scale, past which a parallel scale, of equal length when relatively at rest, moves in the direction of its length; and if light signals are emitted from the two ends of the first scale at the instants when the corresponding ends of the other are coincident therewith; then the signal from the rear end will reach the observer before that from the other end, by an interval consistent with the postulated contraction. The word 'contraction' is, of course, to some extent metaphorical, because the scale which is said to be contracted is simply the one on which the observer is not situated. A more direct expression of the fact is that the 'length' of a scale is measured not by l as ordinarily defined, but by $l\left(1-\frac{v^2}{c^2}\right)^{1/2}$: it is then unnecessary to imagine that anything has happened to either scale.

The statement that a moving clock is slowed down by a definite factor means that if, by any means ordinarily recognized as physically legitimate, an observer compares the rates of two clocks, one moving and the other stationary with respect to himself, he will find them to differ in the manner indicated.

There is no direct evidence for either statement, the experimental difficulties being too great. Circumstantial evidence, however, for the effect described as a contraction of a moving rod is given by the Michelson-Morley and other experiments, and the observational justification for accepting it as verified is very strong. There is no evidence of any kind for the definite retardation of clocks, and it is impossible that there could be, for there is in physics no explicit definition of a clock. The statement that a clock is slowed down in such and such a proportion is therefore meaningless.

A clock is any mechanism which successively records time intervals certified as equal by comparison with the standard intervals adopted at Greenwich and other observatories: the character of the mechanism need not be specified so long as the recorded intervals satisfy this condition. Let us, then, imagine an instrument of hour-glass type, in which a succession of precisely similar particles (for example, grains of sand, drops of water) fall at the standard rate into a receptacle. The time of occurrence of any event is then indicated by the number of particles, N, which have fallen between some chosen zero instant and the instant of occurrence of that event. If M and V are respectively the mass and volume of a particle, then the time is equally well indicated by MN or VN (in each case, of course, a constant factor may be introduced to give the unit of time any desired value). For such a clock at rest, then, the time t between two events is proportional to N, MN or VN.

Now set the clock moving with velocity v, and suppose that when it is moving uniformly, N is changed to N'. Then, by the well-known formulæ, MN changes to $MN'\left(1-\frac{v^2}{c^2}\right)^{-1/2}$, and VN to $VN'\left(1-\frac{v^2}{c^2}\right)^{1/2}$. If, then, dt and dt' be the intervals recorded by the stationary and moving clocks, respectively, between the same events, the ratio dt'/dt will be different in the three cases, as shown in the accompanying table:

dt	dt'	dt'/dt
N	N'	N'/N
MN	$N'M\left(\frac{1}{1-v^2/c^2}\right)^{1/2}$	$N'/N\left(\frac{1}{1-v^2/c^2}\right)^{1/2}$
VN	$N'V\,(1-v^2/c^2)^{1/2}$	$N'/N(1-v^2/c^2)^{1/2}$

All three clocks are equally 'legitimate': hence the restricted theory of relativity gives no information, and makes no assumption, about the behaviour of moving clocks.

It is certain, however, that the mathematical requirements of the theory are represented by the Lorentz transformation formulæ, according to which dt'/dt is unequivocally determined. It follows, then, that the time-coordinate of the

formulæ does not represent (except possibly accidentally in a particular case) the reading of a clock. What, then, does it represent?

To answer this question we note first that t is certainly equal in value to the reading of a clock at rest, though t' is in general not that of a clock in motion. We therefore inquire what t essentially is. The clock with whose readings it agrees was rated by a mean solar time clock at Greenwich, let us say; that, in turn, by a sidereal clock; and that by the revolutions of the celestial sphere (that is, rotations of the Earth). Here Greenwich stops.

It would seem, then, that the time scale of the physics of stationary systems is that according to which successive sidereal rotations of the Earth occupy equal times. But that cannot be so, for we are told that the Earth itself is slowing down. A different, and still more fundamental, standard is therefore implied: What standard is that?

The only way to answer this question is to examine the evidence for the Earth's retardation. It is found in the fact that there is a discrepancy between the calculated and the recorded tracks of ancient eclipses. If the rotation of the Earth actually defined the unit of time, the conclusion would necessarily be that the principles (namely, the laws of Newtonian mechanics) on which the calculations were based were wrong. The conclusion actually drawn, however, is that the discrepancy is due to the gradual lengthening of the day. The drawing of this conclusion commits us to the time scale necessary to justify Newton's laws of motion. What is that time scale?

The first law is sufficient for our purpose. It says that a body free from external influences will move uniformly; that is, equal times are those in which such a body covers equal distances. At last we have reached finality. This is the time scale represented by the co-ordinate t in stationary systems. A clock recording this time scale (we will call it an 'ideal' clock) would be a particle moving freely, without friction, along an infinite space-measuring scale in a region free from gravitational and other fields of force: the 'time' would be the reading of the scale at the instantaneous position of the particle.

No such clock can be made, and we have therefore to use various artificial constructions, with complicated controlling mechanisms, in order to determine what its indications would be. It is not surprising, therefore, that the corrections to be applied to the readings of such artificial constructions when they are set moving, in order to realize the readings which the ideal clock would give if *it* were set moving, are almost as various as the constructions themselves.

We can now see the meaning of t'. If t is the reading of an ideal clock at rest, t' must be that of an ideal clock in motion: or, in other words, t' refers to the time scale which will make the laws of mechanics hold for moving systems. There is no need to make an experiment (which in any case is impossible) to determine the relation of dt' to dt, for that relation is determined logically from the fact of the Fitzgerald contraction. Suppose an ideal clock is set moving in the direction of its space-measuring scale. Since there is, by definition, no force between the particle and that scale, the velocity of the particle relative to the scale must be considered unchanged; that is, the time which the particle of the stationary clock takes to move over n divisions of its scale must be considered equal to the time which the particle of the moving clock takes to move over n divisions of *its* scale. But the latter scale is contracted with respect to the other in the ratio $\left(1-\frac{v^2}{c^2}\right)^{1/2}:1$. Hence the particle of the moving clock moves a shorter distance in the same time: that is, the moving clock must be considered to be running slower than the stationary one in the ratio mentioned.

It appears, then, that the transformation formula for t is a logical consequence of that for x. Only the latter is based on experiment; the former is the necessary consequence if Newtonian mechanics is to hold good for uniformly moving systems despite the change of x. It is useless to look for experimental evidence for the change of t, for if, in any attempted experiment in which the Fitzgerald space contraction were assumed, the Lorentz formulæ were not verified, the only possible conclusion would be that the clock used was not an ideal one, and the necessary corrections would have to be applied to its readings.

Kennedy and Thorndike, in describing their celebrated repetition of the Michelson-Morley experiment with an interferometer having unequal arms[1], state that "Among the several classical experiments which suggested the restricted principle of relativity there appears to be none in which any question as to the nature of time is involved. . . . Hence, although such experiments have suggested the relativity theory, they do not form a sufficient basis for the logical derivation of it." This, as we have seen, is erroneous. What the Kennedy-Thorndike experiment provided was not, as the authors stated, confirmation of the Lorentz transformation for time, but evidence that, if light be regarded in the ordinary way as having a certain "frequency", then that frequency must be subject to the Lorentz transformation if the Fitzgerald space transformation also be assumed. In other words,

the Kennedy-Thorndike experiment showed that light (or, if hypotheses be introduced, a radiating atom) behaves as an ideal clock. This, of course, is highly figurative language, because it is a 'clock' which can neither tell the time nor be used to measure time intervals. The literal interpretation of the experiment is that Newtonian mechanics is peculiarly fitted for the treatment of light as a periodic phenomenon because the association of time and space measurements implied in Newton's first law is just that which makes λ and ν change by reciprocal factors, thus keeping the velocity constant.

Incidentally, two things may be noticed. First, the frequently heard statement that relativity has brought about a fusion of space and time has nothing mystical about it and it is not true. It is not mystical because the 'nature' of space and time is not involved; all that we are concerned with is the fitting together of measurements made in various ways. The statement is not true because the fusion of space and time, in the only sense in which it exists, was made by Newton when he chose, as a measure of time, the spaces covered by a freely moving body. What relativity has done in this regard is simply to show how that measure can be preserved in face of the experimental fact of the Fitzgerald space contraction.

The second point is that the conformability of light to Newtonian mechanics, established by the Michelson-Morley and Kennedy-Thorndike experiments, makes it possible to define corresponding units of space and time in terms of light instead of Newton's hypothetical "uniformly moving body". This is, in fact, what Milne does in his theory of 'kinematical relativity'. In practice the two procedures are equivalent, at least to a high degree of approximation, as we know from experiment. Epistemologically, however, they differ profoundly, since Milne's definitions, being based on theoretically possible observations, are, in principle, rigorously realizable; whereas Newton's are ideal, and any observed departure of a moving body from uniformity of motion can be ascribed either to the time scale used or to the interference of a force. In other words, Newton's first law provides a language but says nothing; it cannot, therefore, be convicted of untruth, and the worst that can happen is that the language may be found inconvenient or incapable of providing expression for everything we find it necessary to say. Milne's postulates, on the other hand, are definite statements, and may be falsified by observation. The chance that this will happen is, of course, minimized by the fact that they are made to conform to all the experimental knowledge available at the present time. This safeguard was introduced by Milne when he modified his theory so as to identify the originally unspecified signals used by observers with light beams.

[1] "Experimental Establishment of the Relativity of Time", *Phys. Rev.*, **42**, 400 (1932).

OBITUARIES

Mr. M. A. Bailey

THE scientific career of Maurice Armand Bailey ran its course to memorable achievement with what almost seemed to be predestined continuity. If circumstance played its part, a mind splendidly equipped for investigation, linked to a grand character, were the prime forces.

From Dulwich Bailey went up to Clare College, Cambridge, to read for the Natural Sciences Tripos and then for the diploma in agricultural science. After three years as a research student at the John Innes Horticultural Institution he joined the Royal Field Artillery in 1915, gaining in France the Military Cross and the rank of brigade major.

The appointment as senior botanist to the Ministry of Agriculture, Egypt, in 1919 turned the young geneticist into a plant breeder. For the next six years Bailey's studies of the cotton plant, recorded in a few excellent papers, developed a scientific attitude and procedure in practical breeding such as have rarely been achieved in that difficult art.

Transfer to the Sudan as plant breeder under the Empire Cotton Growing Corporation (attached to the Sudan Government) gave Bailey a great problem and a grand chance. In that country cotton governs prosperity. A great irrigation scheme in the Gezira makes cotton-growing possible where rainfall is too scant and uncertain for any normal agriculture. But the soil is commonly recognized as the most intractable clay in the world, and climatic peculiarities in many seasons check the growth of cotton despite irrigation.

Average yields of cotton of 3·5 kantars a feddan had become customary and were remunerative, but in 1923 a virus disease, leaf curl, was reported, the occurrence being exceedingly rare. It spread so swiftly that by 1929 the whole Gezira, involving 200,000 acres of cotton, was seriously affected. In the ensuing years cotton yield fluctuated dangerously, but search for causes in soil factors, in seasonal effects and in disease, was for a time in vain. Leaf curl evidently played a great part, and in one bad year yields dropped to 1·36 kantars. Sudan fortunes were gravely menaced, but an outstanding combination of research in plant breeding, in entomology, in mycology, and in crop husbandry gained a victory,

of which the remarkable speed and extent are shown by the cotton yields of the years 1935–38, which were 4·65, 3·72, 4·47 and 4·55 kantars per feddan respectively.

When Bailey retired from the Sudan in 1938, cotton growing in the Gezira had been rescued and initial plans had been laid for the wider agricultural development of the whole country, including the non-irrigated south. Hope that the ability and character by which the Sudan had profited would play a great part in the National Institute of Agricultural Botany, which Bailey came home to direct, was ended by his death in Cambridge on October 16 last at the age of forty-nine.

It was specially fitting that a scientific worker born and educated in England and provided by Egypt with great opportunities for studying cotton should do his culminating work in the Sudan, in which these two countries have a condominium. He played two parts there. For the first six years plant breeding occupied all his time: for the remaining seven he was director of agricultural research. It was Bailey's clear planning and quiet persistent influence which led to the complete reorganization of the research service. He infused into it the spirit which has made it remarkable for success in conjoint work.

Leaf curl was checked by two lines of action. The Entomological, Mycological and Agricultural Sections, by a series of fine investigations, identified the vector (the white fly, an Aleurodid) and found means of exercising a considerable degree of control over it in field practice. Meanwhile, the Plant Breeding Section set itself to examine the possibilities of obtaining, by selection or crossing, new varieties which, while equal in lint qualities to the customarily grown Sakel variety and adapted to the peculiar Gezira environment, had the further merit of specific resistance to leaf curl. Hybridization had to be discarded because of its inevitable slowness, and all effort was concentrated on selection. The field was ultimately narrowed down to plants resulting from a single selection out of a field crop of Sakel in the Gezira made by Mr. A. R. Lambert of the Botanical Section in 1926. There finally resulted two strains known as *X* 1530 and *X* 1730 which, showing in trials all the desired attributes, had spread to an area of 130,000 acres in 1937–38. Systematic plant breeding has nowhere produced a quicker or more significant result than this. F. L. Engledow.

Prof. A. P. Orekhov

The death occurred on October 19, at the age of fifty-eight, of Prof. Alexander Pavlovich Orekhov, member of the Academy of Sciences of the U.S.S.R.

Orekhov was one of the most eminent experts in the chemistry of alkaloids in the Soviet Union. Concentrating his main research on vegetable bases, he ascertained that most of the alkaloids were not specifically characteristic of definite vegetable species or families and that one and the same alkaloid or alkaloids of similar structure may be found in plants of different families. Under his guidance more than eight hundred kinds of new vegetable raw materials were studied, found mainly in the southern republics and provinces of the U.S.S.R. During this research were discovered a hundred new alkaloid-bearing plants and ten new families, previously not known to possess alkaloid-bearing representatives.

Orekhov established the structure of anabazine, salsoline, salsolidine, convolvine and certain other vegetable bases. Many of the alkaloids he isolated were afterwards identified as substances already known and obtained by other investigators from quite different vegetable raw materials. From the point of view of scientific theory, of special interest is his elucidation of the structure of the alkaloids convolamine and convolvine, which have been proved to be ethers of veratric acid and tropine. It was thus ascertained that the derivatives of tropine are encountered in quite new families hitherto not held to be alkaloid-bearing.

A. P. Orekhov created his own school of research workers, and the laboratory which he directed at the Chemical Pharmaceutical Institute attached to the Commissariat of Health became the principal centre for the study of the chemistry of alkaloids. His work on "The Chemistry of Alkaloids" is the standard work on the subject in the Soviet Union. He was elected a member of the Academy of Sciences of the U.S.S.R. in January of this year.

Prof. C. F. Shaw

The death of Prof. C. F. Shaw of California removes one of the most prominent of America's pedologists. Prof. Shaw gained a reputation from his studies in the field of pure rather than applied soil science, his name being especially associated with the question of soil classification. He spent several years studying Chinese soils, besides having a wide experience of American conditions. His revolving-disk method of measuring and specifying soil colour has been one of the more notable advances in the technique of soil physics in recent years. He was an ardent believer in the American binomial system of soil nomenclature, and had been engaged for some years prior to his death in collecting and collating a world list of 'soil-series' names, which was to serve systematic pedology as the Linnean system has served botany. G. V. J.

We regret to announce the following deaths:

Mr. P. H. Grimshaw, formerly keeper of the Natural History Department of the Royal Scottish Museum, on November 14.

Dr. R. von Ihering, chief of the Serviço Federal de Piscicultura, Rio de Janeiro, on September 15, aged fifty-six years.

Dr. T. L. Prankerd, lecturer in botany in the University of Reading, on November 11, aged sixty-one years.

Sir William Prout, K.C.M.G., O.B.E., senior consulting physician to the Colonial Office during 1927–29, on November 18, aged seventy-seven years.

NEWS AND VIEWS

Germanization and the University of Prague

Ruthless as have been the measures of repression directed by the Germans against Czech students and intellectuals for their part in the demonstrations on Independence Day, October 28, and the following days in the city of Prague, yet none will give rise to deeper resentment, nor have more far-reaching effect than the closing of the University and the technical schools. Not only do the Czech people feel a special pride in the University of Prague as the oldest University in Eastern Central Europe, but also the University has always been a central rallying point in the development of Czech national life and national culture. So long ago as the thirteenth century, Prague was a gathering place for students, and when in the middle of the fourteenth century it was recognized under a Bull of Pope Clement VI, Charles IV, Emperor and King of Bohemia, its founder, while organizing it on the model of Paris, of which he had been a student, in four "nations", intended that primarily it should serve the needs of students from Styria. Nevertheless, it drew its students from all parts of Europe, and in repute equalled the greatest of the medieval universities. It was, however, after the Napoleonic wars and in the earlier half of the nineteenth century that the University attained its greatest measure of influence in the development of a Czech national culture and consciousness. Not only was the study of the national language and antiquities taken up with ardour, but also industrial development was fostered in the movement which led to the foundation of the technical schools. In the course of events which followed on the War of 1914–18 the University has been no less active in promoting in the people a consciousness of their historical and intellectual heritage. Its suppression will have repercussions of which a better knowledge of their own history might have conveyed a warning to the Nazi leaders.

The Advancement of Science

The first quarterly part of the *Advancement of Science*, the new journal of the British Association which is being issued in place of the annual volumes published by the Association from 1831 until 1938, contains the presidential address of Sir Albert Seward, "The Western Isles through the Mists of Ages", as well as the presidential addresses to Sections D (Zoology), H (Anthropology) and K (Botany), with abstracts of communications to those Sections. An admirably written introduction reviews the Dundee meeting and the circumstances which led to the premature termination of an exceptionally promising and well-attended meeting, and also indicates the tentative policy of the new journal, which it is hoped will make a wider appeal to lay readers than an annual volume could do. The number also includes reports of research committees to Sections D, H, and K, as well as the report of the Council to the General Committee for the year 1938–39, and the report of the Division for the Social and International Relations of Science for the same period. Among the subjects which have received attention by the latter Division, other than those forming the subject of public meetings, are the incidence of taxation on scientific research; areas and objects worthy of protection on scientific grounds; recommendations on details demanded in census returns and their analysis; scientific news in the Press; scientific exhibitions; co-operation with the International Council of Scientific Unions in relation to questionnaires on science and society; and assisting the Society for the Protection of Science and Learning. The number also includes a first instalment of a scientific survey of Dundee and district.

Soil Problems in the Tropics

In the editorial article entitled "White Settlement in the Tropics" of Nature, July 29, 1939, reference was made to the insistence in the report of the Commission appointed to inquire into the possibilities of white settlement in British Guiana on the "inherent poverty of many, perhaps most, tropical soils" in contrast to earlier beliefs in their inexhaustible fertility. Writing from the East African Research Station, Amani, Mr. G. Milne foresees a danger that facile generalizations regarding tropical soils as such may result. He points out that "tropical soils tend to be poor when the climate is very wet, when the soils are of advanced maturity, when (like any other soils) they have suffered from man-accelerated erosion, or when their parent materials have been exhausted of plant nutrients by previous geological processes". One or more of these factors has rendered huge areas of East Africa infertile, but there are still large tracts where pessimism on grounds of intrinsic soil infertility alone is not justified. Recent work has made it clear that neither the luxuriance of natural rain-forest cover nor of grassland vegetation affords a reliable guide to the agricultural value of soils (Hardy, F., *Trop. Agric.*, **13**, 315; 1936: Walter, H., *Forstliche Wochenschrift Silva*, **22**, 201; 1936: Milne, G., *East African Agric. J.*, July 1937), and that therefore an ecological survey cannot take the place of a soil survey. The fundamental principle seems to be that a high forest has matured along with the soil that nourished it; in the old age of both, the forest comes to depend very little on further material supplies from a highly leached and impoverished soil. Two things seem clear: one that the principles of good soil management in the tropics have yet to be fully understood, the other that tropical soils are liable under improper management

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NATURE

SUPPLEMENT

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SHORT REVIEWS

AGRICULTURE

Humus

Origin, Chemical Composition and Importance in Nature. By Prof. Selman A. Waksman. Second edition, revised. Pp. xiv+526. (London: Baillière, Tindall and Cox, 1938.) 30*s*.

THIS treatise, first published in 1936, is now recognized as the standard text-book of the science of humus, or 'humology', as the science has been called. The literature of humus is so diffused that the treatment of the subject in agricultural and soil science text-books must necessarily be somewhat superficial and inadequate to the importance of the subject. The fact that the chemistry, physics and biology of humus do not lend themselves to easy interpretation in terms of orthodox science is the main stumbling-block to progress in knowledge of the soil.

The book is in three parts. The first deals with the historical development of humus studies, the changing conceptions of the origin and composition of humus, and the reasons for the highly confused state of our knowledge of it. The nine chapters comprising the second part begin with the more rational approach to the subject, adopted about the commencement of the present century, in which the study of plant residues and the processes of their decomposition led to the modern conception of humus as a highly complex and changing group of organic and mineral substances. The decomposition of humus and its functions and applications in agriculture and industry occupy the remaining five chapters of the book, including a new chapter on humus and soil conservation.

The bibliography of 1608 references indicates the immense amount of work that has been devoted both to the investigation of humus and to the compilation of the book. If the amount of definite knowledge gained is disproportionately small to the amount of labour expended, it is nevertheless some of the most significant in the whole realm of soil science, and Dr. Waksman is to be congratulated on his selection of relevant facts and their condensation into a very readable and intelligible form.

Ce qu'il faut savoir des plantes des montagnes

Par P. Du Manoir. (Savoir en histoire naturelle, Vol. 5.) Pp. 54+40 plates. (Paris: Paul Lechevalier, 1939.) 16 francs.

Ce qu'il faut savoir pour manger les bons champignons

Par G. Portevin. (Savoir en histoire naturelle, Vol. 6.) Pp. 94. (Paris: Paul Lechevalier, 1939.) 12 francs.

THESE two little monographs are attractive in design, but any botanist would take issue with the claim that the contents represent what it is necessary to know on the subjects dealt with. Rather are they harmful in suggesting that, in the case of the alpine plants, with an idea of colour and size and a few notes on habitat, plants may be recognized by comparison with a rather impressionist representation in colours, usually of the flowering shoot alone.

The monograph on fungi does not pretend that the amateur can be sure to collect edible fungi on the basis of the brief descriptions of the fungi that it contains; it contents itself rather with suggestions as to modes of preparing the edible forms for the table when they are collected. Emphatically, however, this restricted field does not include what it is necessary to know before collecting and cooking fungi for the table.

ARCHAEOLOGY AND ETHNOLOGY

Buried Empires

The Earliest Civilisations of the Middle East. By Patrick Carleton. Pp. 290+12 plates. (London: Edward Arnold and Co., 1939.) 10*s*. 6*d*. net.

MR. CARLETON has excavated in Iraq as a member of Sir Leonard Woolley's archæological expeditions to Ur, and he is a student of cuneiform. He writes, therefore, with the authority of first-hand knowledge; and his narrative of Mesopotamian pre- and proto-history, intended primarily for the general reader rather than the expert, summarizes in a vivid and eminently readable form the results of archæological research from the beginnings, so far back as present knowledge

goes, down to the earlier half of the second millennium B.C. With commendable honesty, but also doubtless with results which will prove disconcerting to the novice in these studies, Mr. Carleton adds an appendix on the material in the tablets of Mari, discovered after the main body of his narrative was completed, and it was too late to make any drastic revision. Hence the chapters dealing with Hammurabi and the Babylonian dynastic history, at least in their chronology and its implications, must, he points out, be set aside as superseded.

A valuable feature of the book is an excellent summary of the evidence relating to the civilization of the Indus valley and discoveries at Mohenjo-daro and Harappa, a subject on which too little provision has hitherto been made for the interests of the uninstructed.

If Mr. Carleton's narrative, excellent as it is, is open to criticism, it is due to the fact that it follows closely the tradition of earlier writers in devoting a preponderating attention to the personalities and achievements of the rulers, and to dynastic history, whereas recent studies have tended to show that the vital importance of Mesopotamia in the history of civilization lies in its contribution to the development of culture, rather than as a series of phases of 'history' in the narrower sense generally adopted.

Monographie des Betsileo (Madagascar)

Par H.-M. Dubois. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 34.) Pp. xviii+1510+10 plates. (Paris: Institut d'Ethnologie, 1938.) 275 francs.

M. DUBOIS' monumental study of the Betsileo of Madagascar, running to more than fifteen hundred pages, is the product of thirty years' patient and careful observation conducted while the author was resident among them. Not only is it encyclopædic in scope, but also it may be regarded, as one critic has said, as indeed definitive.

M. Dubois has divided his work into four parts. In the first part he describes the geographical setting and considers racial history. In the second he deals with the individual, his life and the family and social environment in which it is passed. In the third he describes religious belief; and in the fourth art, language and literature.

In his discussion of general conclusions, M. Dubois makes no claim to have solved finally the problem of origins. His racial analysis of the population of Madagascar distinguishes four racial groups or influxes—Negrillo, Negro, Negroid and Indonesian. The Betsileo are to be assigned to the Negroid; but there is in them a strong strain of the earlier Negro and Negrillo stocks. Their economy is one of rice cultivation combined with cattle raising. Descent is patrilineal; and the sense of family solidarity is strong, centring in the cult of the ancestors as the founders of the family group. In essentials, however, the religious beliefs are fundamentally a doctrine analogous to the *mana* of the Pacific, demonstrated most emphatically in their taboo practices and their relations to chiefs.

African Genesis

By Leo Frobenius and Douglas C. Fox. Pp. 265. (London: Faber and Faber, Ltd., 1938.) 12*s*. 6*d*. net.

THIS volume contains a number of legends and folk-tales selected from the collections made by Dr. Leo Frobenius among the various peoples he has visited in his numerous expeditions in Africa for the purpose of studying prehistoric rock-engravings and paintings. Hence in geographical distribution they cover a wide field, ranging from North Africa to Southern Rhodesia, and ethnically include Kabyle, the Sudanese tribes, Hausa and in the south Wahunga and Bathonga. Most, but not quite all, have been selected for the light they may throw on the meaning and purpose of the rock-drawings and paintings. Thus in the Kabyle creation legends, the parts played by bull and ram explain the prominence of these animals in the art, while the raised arms of a human figure before the bull in a certain drawing is a sign of adoration, and not of panic as has been thought. It is interesting to find what would appear to be a trace of the influence of Egyptian royal marriage custom in these legends.

The stories are sufficiently varied in style and subject to please all tastes, and their literary merits on the whole are high. The Kabyle tale of the jackal and lambs, with the substitution of jackal for wolf, is identical with that in Grimm. "The Old Woman", a tale told by the Hausas, is a piece of stark realism; but the legends of the Sudanese, especially "Gasera's Lute" of the Soninke, and "Blue Blood" of the Fulbe have the epic quality of European medieval romance.

The illustrations are drawn from the rock art and there is a praiseworthy liberality in the matter of sketch maps. The translation is excellent.

BIOLOGY

Flora of Assam

Vol. 3: Caprifoliaceæ to Plantaginaceæ. By U. N. Kanjilal, A. Das, P. C. Kanjilal and R. N. De. (Published under the authority of the Government of Assam.) Pp. x+578. (Shillong: Forest Office, 1939.) 12 rupees.

INDIA has need of provincial or regional floras, and the present volume is a welcome addition to the few existing ones. This is the third volume comprising the Gamopetalæ in the sequence of the "Genera Plantarum"; the previous volumes appeared during 1934–38.

The work has been carried out by four forest officers (the senior of whom was the author of "Forest Flora of the Jaunsar, etc., Forest Divisions", who died some years ago), under considerable difficulties as they have access neither to a good herbarium nor to an adequate library. This handicap becomes evident when one turns to nomenclature. The position is explained by the chief editor in the introduction. In some cases modern ideas have been adopted, in others the older authors have been followed. This will be confusing to users who cannot

refer to original works, particularly so as reference has not been made to the "Flora of British India" when the combinations there used have not been retained; for example, unless one has access to Mez's monograph of the Myrsinaceæ there is nothing to indicate that the genus Sadira was treated as Pimelandra in the older work. Again (p. ix) it is stated that Mez "calls *Embelia Nagushia* Don, *E. undulata* as he identified *E. Nagushia* Don with *E. vestita* Roxb. In this work Brandis has been followed." But a reference to Mez shows that it is *E. Nagushia* Clarke not Don that is termed *E. undulata* (Wall.) Mez and that *E. Nagushia* Don is sunk in *E. vestita* Roxb. The error is of Brandis but only detectable by a reference to Mez.

Descriptions of families, genera and species are given, but the tendency is to pay greater attention to plants of importance in forestry. There is no key to the families (this may be deferred to the final volume), but keys are provided for genera and species when there are more than one of either, and these in general are satisfactory.

There has been a steady improvement in the several parts, but there are still shortcomings in the present volume, especially in the matter of misprints.

It is not clear why certain species are treated differently from the rest in the same genus; for example, under Agapetes sixteen species are included in the key and are serially numbered, but seven further species appear without numbers and with shorter descriptions and in smaller type.

Despite the difficulties encountered, the authors are carrying out a task the fruits of which will prove of great assistance to all concerned with the phanerogamic flora of Assam.

The Comity of Spiders

By Dr. William Syer Bristowe. Vol. 1. (Ray Society, Vol. 126, for the Year 1938.) Pp. x+228+19 plates. (London: Bernard Quaritch, Ltd., 1939.) 25*s*.

THE first volume of Dr. Bristowe's "Comity of Spiders" deals mainly with the distribution of spiders in Britain. Some seventy-five years have passed since the publication of Blackwall's fine work, "A History of the Spiders of Great Britain and Ireland", and meanwhile our knowledge of the British fauna has been much enriched, notably by the researches of the Rev. O. Pickard Cambridge and Dr. A. R. Jackson. Dr. Bristowe, himself an able and enthusiastic collector, has also made many interesting additions and these advances are incorporated in the most useful section of his book, a list of the 556 known British species under their presently accepted names. For each species the distribution within Britain is given by counties from records largely made by the author himself, and the distribution outside Britain, so far as known, is indicated in general terms. One or two nomenclatorial changes are made, but synonyms are not otherwise listed.

The second half of the book examines the effect of environment on distribution and, besides more general considerations of climate, soil, and flora, it summarizes the results of collecting in a wide variety of habitats, natural and artificial, from sewage works to Buckingham Palace gardens. Dr. Bristowe has already published much of the matter in this section during recent years in the form of short papers, but the repetition is justified in a general treatise of this nature.

The monograph includes a discussion of dispersal in which the author stresses the importance of transport by aerial currents, and the book ends with a short chapter on the relative abundance of the spider population in the few localities which have been investigated.

The plates are well reproduced from excellent photographs and, although photography is not the ideal method of illustration, they will be a useful supplement in the identification of British spiders. Printing and production reach the high standard expected of Ray Society monographs, and Dr. Bristowe is to be complimented on a clear and readable style which is all too rare in scientific writings.

R. J. W.

An Account of the Genus Dioscorea in the East

Part 2: The Species which twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. (Annals of the Royal Botanic Garden, Calcutta, Vol. 14, Part 2.) Pp. 425–528. (Alipore: Bengal Government Press, 1939.)

PART I of this monograph, reviewed in NATURE of January 29, 1938, dealt with the species of Dioscorea which twine to the left. The distribution of Part 2, treating of those that twine to the right, has been delayed, and under existing conditions this delay is indefinite. The portion of it now under review contains only the final summary and no systematy. In view of the delay in publication, advance separates of this summary have been obtained by the authors for presentation to institutions specially interested in biogeography. It presents thirty-five tables analysing in detail the distribution of the species described (147 in all) over the oriental range of the genus. A short but necessary discussion on "the meaning of the word species" defines the position adopted by the authors towards this vexed subject. It is followed by an exhaustive 'retrospect' in which is expounded an account of the systematic study and exploratory research devoted to the genus in the past, with particulars of the authors and collectors who have contributed to knowledge of the group. That there is still much to be elucidated is evident from thorough investigations under the title "Estimate of the Imperfection of Present Knowledge".

Finally, we have a dissertation on the biology of the species concerned, concluding with an exposition of the phytogeographic scheme adopted. To many botanists, especially on the ecological side, and to biologists generally, this part will prove more interesting and valuable than the mere systematy. It contains ample evidence in its pages of the enormous amount of labour and research put into the work.

It is to be hoped that workers in the group and area will not be for long deprived of the remaining portion.

An Architect of Nature

Being the Autobiography of Luther Burbank. With Biographical Sketch by Wilbur Hall. (Thinker's Library, No. 76.) Pp. xvii+139. (London: Watts and Co., 1939.) 1*s.* net.

IN this autobiography Luther Burbank reveals what proved to be the driving force behind his amazing life when he wrote "Darwin made important and absolutely new findings with regard to pollenization and fertilization, but, when he made them and set them down, he left it to others to make the rules useful". Burbank took it upon himself to be a pioneer among those "others", and now "every schoolboy knows" how he rapidly built up new species of plants by selecting with a knife, a hoe, or a spade and bonfire rather than by allowing new forms to develop more slowly under the deadly environmental competition of Nature.

In an introductory biographical sketch to this little volume, Wilbur Hall describes how Burbank had reached the age of seventy years before he felt constrained to express on paper the more important thoughts, observations and philosophical speculations of his life. This book represents all that he limned in his own words, so that one would expect it to remain a fount of delight to all who are interested in the man who was "blasphemed, preached about, talked at, written to, telegraphed, scolded, abused, and even vilified" merely because of his attempts to speed up Nature's methods by making use of keen and discerning man-made selective processes in the production of new types of plants. T. H. H.

On Miasmata and Contagia

By Jacob Henle. Translated by Dr. George Rosen. Pp. 77. (Baltimore, Md.: Johns Hopkins Press, 1938.) 1 dollar.

THIS important essay by one whom Garrison describes as the greatest German histologist and one of the greatest anatomists of all time, was originally published in 1840 in Henle's "Pathologische Untersuchungen", and contains the first clear statement that living organisms are the cause of contagious and infectious diseases. Dr. George Rosen, who has provided an excellent translation, points out that Henle's theory was not based on any personal experiments but on the data collected by his predecessors, such as Athanasius Kircher and Leeuwenhoek in the seventeenth century, who described infusoria and other microscopic animalcules, Wichmann who discovered the *Acarus scabiei*, Agostino Bassi who found that muscardine, an infectious disease of silkworms, was caused by a fungus, Cagniard de la Tour and Schwann, who showed that fermentation was due to yeast, and Schönlein, who discovered the parasitic cause of favus. Henle maintained that in infectious disease the morbid matter increased from the time that it entered the body, and that it must be organic in nature as only living organisms were able to do this. His view that the organism probably belonged to the plant kingdom was confirmed by Robert Koch, one of the most eminent of his pupils, more than thirty years later.

A Manual of Practical Anatomy

A Guide to the Dissection of the Human Body. By Prof. Thomas Walmsley. Second edition. In 3 Parts. Part 2: The Thorax and Abdomen. Pp. viii+331+7 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 12*s.* 6*d.* net.

THE principal changes in the new and greatly enlarged edition of this work, of which the first appeared in 1921, are the introduction of fuller accounts of the examination of the living body, and especially of parts important in clinical practice, a short description of the action of muscles and the changes in the form of parts when they function, the incorporation of numerous new figures and skiagrams of the stomach, intestines and urinary tract, and a change in the nomenclature to that adopted by the Anatomical Society of Great Britain and Ireland.

The book may be warmly recommended as an excellent practical guide for the dissector.

General Science Biology

By A. Spencer White. (Dent's Modern Science Series.) Pp. vii+243. (London: J. M. Dent and Sons, Ltd., 1939.) 2*s.* 3*d.*

THIS work has been prepared as a companion volume to the already published "General Science Physics" and "General Science Chemistry" by the same author. The text is largely based on the reports of the teaching of general science compiled by the Science Masters' Association, and is intended to cover the biology section of the general science syllabus of the School Certificate examinations. The material is presented in quite an interesting manner, great prominence being given to experimental work. The inclusion of subjects which would involve the use of the microscope is questionable, although use might be made of them as demonstrations. There is an abundance of supplementary line-drawings, which possess a diagrammatic clarity and simplicity that might usefully serve as a model for pupils.

Reminiscences of Country Life

By James George Cornish. Edited by Vaughan Cornish. Pp. xi+147+8 plates. (London: *Country Life*, Ltd., 1939.) 10*s.* 6*d.* net.

THESE reminiscences cover a period of seventy years of life in rural England—country parishes in the counties of Suffolk, Berkshire and Devon. Their author, James George Cornish, was born in 1860 and died in 1938. Throughout his life, as these records bear witness, he was gifted with an observant eye for the life of the countryside and individual traits in the character of the countryman. His reminiscences have been edited by his brother, Dr. Vaughan Cornish. As he points out, they derive no inconsiderable value from the fact that they preserve continuity over a very considerable period of time. This is especially interesting as in these years crucial changes took place in English agriculture and modes of country life.

CHEMISTRY

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 63: Ruthenium. Pp. xxvi+124. (Berlin: Verlag Chemie, G.m.b.H., 1938.) 6.50 gold marks.

THE section on ruthenium in Gmelin's "Handbuch" contains an account of the physical and chemical properties of this polyvalent element and of its compounds. The sources and preparation of the metal are being dealt with in conjunction with other members of the platinum group. No fewer than seven isotopes have been detected by the mass-spectroscope, and artificial radioactivity has been effected by bombardment with slow neutrons and deuterons. Ruthenium is very resistant to atmospheric corrosion and the attack of strong acids, but it can be oxidized in the presence of potassium chlorate to the tetroxide and by fused alkalis to ruthenates.

Ruthenium is an excellent catalyst, particularly for oxidations, being superior to platinum in this respect. A list of references to this application as catalyst is given. It gives rise to a large number of complex co-ordination compounds, including a stable, volatile carbonyl $Ru_3(CO)_{12}$, a red pentanitrosyl and many ammines and derivatives of organic bases. Among these complex compounds is the deeply coloured derivative of tervalent ruthenium called 'ruthenium red', which has the power of dyeing natural silk. Morgan and Burstall have shown that it is a chloro-hydroxo-tetrammine monochloride with co-ordination number 6. They have prepared from it a dichlorotetrammine monochloride, which reacts with ammonia to regenerate ruthenium red. The constitution of this derivative seems to be uncertain, since Gleu and Breuel have recently described both *cis-* and *trans*-dihalogenotetrammine halogenides, which do not react with ammonia. A list of derivatives of organic bases containing ruthenium is given.

Physico-Chemical Experiments

By Prof. Robert Livingston. Pp. xi+257. (New York: The Macmillan Company, 1939.) 10*s*.

THEORETICAL introductions to physical chemistry are plentiful—practical books on the same subject are only too rare. Dr. Livingston's compact and informative book arrives at an opportune period. Physical chemistry has now become so wide a subject, and uses such specialized technique, that it becomes increasingly difficult to write a practical book which will include a selection of experiments illustrating new principles with sufficiently modest and fool-proof apparatus.

In the volume under notice, classical physical chemistry is there with all up-to-date improvements. There are, however, many welcome innovations in so small a book. For example, some experiments in radioactivity are described, absorption spectra find a useful place; there is a good discussion of, and a simple experiment with, a plate still. Chemical kinetics is represented by more interesting types of reaction than are customarily found in practical books. The section on electrochemistry is equally good. Even simple photochemical and colloidal experiments assume their proper place in the volume. But especial commendation must be accorded to the author for his excellent chapter on measurements, errors and computations. This is a chapter which may be read with great profit by advanced students of physical chemistry. This apparently modest little book, full of relevant information, therefore puts modern physical chemistry within the reach of any laboratory.

H. W. M.

Factual Tests in Inorganic Chemistry

(Post School Certificate Standard.) By F. A. Philbrick. Pp. 80. (London: G. Bell and Sons, Ltd., 1939.) 1*s*.

Answers to Factual Tests in Inorganic Chemistry

By F. A. Philbrick. Pp. 13. (London: G. Bell and Sons, Ltd., 1939.) 6*d*.

THIS book of "Factual Tests" is designed to test the student's grasp of inorganic chemistry up to Higher Certificate and Intermediate B.Sc. standard. Each question is set in such a way that the student has merely to select the correct answer from five alternatives and write down its number. Thus to answer: "34. The ammonium salt used in the Leclanché cell is the 1 sulphate, 2 chloride, 3 nitrate, 4 carbonate, 5 phosphate"; the student merely writes down the figure 342.

The questions are set out in 'papers' which cover the chemistry of either one element or a group of related elements, and the numbering is devised so that all answers require a three-digit figure. The correct answers are supplied in a separate booklet, as recorded above.

There are clearly many advantages in having a book which can be used by student and teacher to test rapidly and objectively the factual information which has been acquired, without always having recourse to the wearisome tasks of writing out and correcting answers to the conventional type of question. In the opinion of the reviewer, "Factual Tests" should also have included questions which require a one- or two-word answer, but in spite of this omission it should prove of use to both students and teachers.

A. C. C.

A Course of Study in Chemical Principles

By Prof. Arthur A. Noyes and Prof. Miles S. Sherrill. Second edition, rewritten. Pp. xxv+554. (New York: The Macmillan Company, 1938.) 21*s*. net.

THE subject-matter has been thoroughly revised in the second edition of this book. A considerable improvement has been made by dealing with the first and second laws of thermodynamics at the beginning instead of at the end of the book. The kinetic theory has been considered in greater detail, and the essential features of the Debye-Hückel ion attraction theory have been added. The text, as in the old edition, is interspersed with problems which should prove of considerable value to university students.

A. C. C.

Engineering

Airplane Structures

By Prof. Alfred S. Niles and Prof. Joseph S. Newell. Vol. 1. Second edition. Pp. xv+451. Vol. 2. Second edition. Pp. viii+177. 13*s*. 6*d*. net. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.)

THE revised edition of this book, now expanded into two volumes, attacks the problem of aircraft structural design from the point of view of the designer who may wish to apply the advances that scientific thought have made available to his problem. It discusses all of the methods of design and analysis that have been used successfully, and by the use of illustrative examples endeavours to show the best uses and the limitations of each.

The introductory chapters are devoted to the aerodynamic questions from which the conception of the applied external loadings is derived, and although naturally not complete in their scientific discussions of these problems, they do define them sufficiently to make clear the loadings that the structural designer is called upon to resist. The bridging of this gap has been conspicuously absent from published works hitherto.

The main portion of Volume 1 is then devoted to the various accepted methods of structural analysis, with applications, and includes a chapter on the strengths of methods of joining structural elements together, such as are acceptable in the somewhat peculiar aircraft practice. A very useful chapter on deflection and stiffness treated as a design problem finishes off the first volume.

The second volume contains a discussion of indeterminate structures, and gives many excellently worked out examples occurring in aircraft problems. The treatment of stressed skin structures is the least satisfactory part of this work; but these are problems still in their infancy, and about which controversial views are necessarily held until the correct practices have been established by experience.

In general, it can be said that this is an excellent book for both students and designers. It contains an unusually large number of tables, charts, and such aids to routine design work not always found in textbooks; further, these are set out in a manner calculated to make them of greatest use to the practical designer.

Foundations and Earth Pressures

By C. Hyde Wollaston. Pp. 295. (London: Hutchinson's Scientific and Technical Publications, 1939.) 21*s*. net.

IN recent years, increasing attention has been given to investigation in that branch of science designated soil mechanics, which deals with the behaviour of soil when treated as a material of construction. An account has been given in the report of the Building Research Board of the advances made in this branch, and it is therefore of especial interest and value to have the views of an engineer as to the methods of putting into practice such information as is available. These have been expressed with clearness and a full force of conviction by C. Hyde Wollaston, late chief engineer in the Public Works Department of Burma. His aim is to bring home to engineers the desirability and importance of treating soils as materials of construction and with the same attention as is given to timber, steel, and concrete.

The author shows that soil mechanics provides a far more reliable and certain guide than is generally supposed, and explains how soil testing should properly be conducted. A clay soil, hitherto the bugbear of engineers, need no longer be regarded with suspicion. Its 'water-content' is now known to be a sure criterion of its strength against compression. In the first part of the book foundations are dealt with, and in the second part the author turns his attention to earth pressures and retaining walls. The practical application of the new ideas on these subjects is exhibited in some fifteen examples which constitute the third part entitled "Designs and Calculations". Here are treated actual designs ranging from a simple column footing to a reinforced concrete retaining wall and calculations of the stability of bridge piers useful both to the student and the practitioner.

Mathematics and Astronomy

The Theory of Functions

By Prof. E. C. Titchmarsh. Second edition. Pp. x+454. (London: Oxford University Press, 1939.) 25*s*. net.

THE second edition of Prof. Titchmarsh's "Theory of Functions" has been produced photographically from amended sheets of the first, with the transfer of the main account of the gamma function to the chapter on analytic continuation and the insertion at the end of the chapter on integral functions of two theorems on asymptotic values and an introduction to the theory of meromorphic functions which will send the reader eagerly to Nevanlinna. The list of memoirs consulted is unchanged; the list of books recommended is of a more useful kind than in the first edition, but in an epoch when every weakening of international bonds is to be deplored, we regret that anyone should decide to restrict such a list so far as possible to works in English; the result in this case is that whereas in 1932 a total of 25 titles was composed of 16 in English, 11 in French, 7 in German, and a translation, in 1939 a total of 24 titles includes 19 in English and two translations.

Page numbers have been preserved, at a cost: there is only one page between 255 and 265, and this is numbered 256–64; on the other hand, 284 is followed by seven pages numbered 284*a* to 284*g*, and then odd numbers take the left hand and even numbers the right until a blank unnumbered page at the end of the chapter restores the usual location. Since references throughout are to sections, not to pages, the economy seems petty.

The success which this book has achieved proves that Prof. Titchmarsh was right in anticipating that the collection which he describes too modestly at consisting of "rather disconnected introductions to

various branches of the theory of functions" would be of service to students to whom the mass of existing literature appeared "rather formidable". It proves, too, that early reviewers were right in recognizing a quality of readability in his writing; in effect, the advice given to students was: "This is a book from which you will be able to learn how to do mathematics", and we cannot do better than repeat this advice with all the confidence that comes from knowing that it has been endorsed by those best situated to discover that it was sound, namely, the students who have followed it. E. H. N.

Planetary Co-ordinates for the Years 1940–60 referred to the Equinox of 1950·0

Prepared by H.M. Nautical Almanac Office. Pp. xvi+150. (London: H.M. Stationery Office, 1939.) 17*s.* 6*d.* net.

THE present work is a continuation of the previous volume published in 1933, which contained certain ephemeral data up to 1940; it extends these from 1940 to 1960. The general arrangement is the same as in the first volume, but certain alterations have been introduced which add considerably to the convenience of the tables. As computing machines will be used almost entirely in connexion with the work, the logarithm of the radius vector has been omitted and a column giving the Julian date has been inserted.

Those who are engaged in the computation of planetary perturbations will find a great convenience from the method of arranging the planetary co-ordinates. The material for Venus and the Earth is printed on facing pages, and the same applies to Jupiter and Saturn, the ephemeris for the latter planet being given for intervals of 10 days instead of 20 days as in the previous volume. The material for Uranus and Neptune is also printed on facing pages, intervals of 40 days being retained as before. The attractions of the sun are given to an extra decimal, the last figure retained being the tenth decimal. This refinement is quite unnecessary for comets, but will have an important application in the case of the perturbations of minor planets. The late Prof. Numerov and Dr. Bower outlined a scheme for the computation of very accurate ephemerides of certain minor planets, from which systematic corrections to star places could be determined, and the extra figure will serve a useful purpose here.

The first volume gave the spherical co-ordinates of Uranus and Neptune from 1903 to 1940 at intervals of 200 days, and the present volume includes these co-ordinates from 1800 to 1903. Full details are given of the application of Cowell's method for the computation of perturbations, Comet 1933*f* (Whipple) being selected for the purpose. This particular part of the work was done by Miss F. M. McBain under the direction of the Superintendent. It is scarcely necessary to add that the volume will be invaluable to computers in various branches of astronomical work. M. D.

Astronomy

A Textbook for University and College Students. By Prof. Robert H. Baker. Second edition. Pp. xx+522. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1939.) 16*s.* net.

THE first edition of this work appeared in 1930 and the second edition in 1933. Two reprints of the later edition appeared in 1934 and 1935 and the present volume is a third reprint. While the book is excellent in many respects, it is regrettable that a third edition was not produced instead of a reprint. This would have brought it up to date and would have enhanced its value very much. As one instance of the necessity for a new edition, we may refer to the story of Galileo and the Leaning Tower of Pisa, repeated on p. 151. Prof. Lane Cooper has shown that there is no foundation for the story, and Prof. A. S. Eve, while not agreeing entirely with Cooper, nevertheless concludes that "definite historical evidence is lacking" (NATURE, **137**, 8, Jan. 4, 1936). It is to be hoped that a new edition will be put in preparation. M. D.

MISCELLANY

Aequanimitas

With other Addresses to Medical Students, Nurses and Practitioners of Medicine. By Sir William Osler. Reprinted from the third edition. Biographical Note by Sir Walter Langdon-Brown. Pp. xiv+452. (London: H. K. Lewis and Co., Ltd., 1939.) 7*s.* 6*d.* net.

THIS book, which contains the best-known of Osler's minor writings, consists of twenty-two addresses, seventeen of which were delivered in various parts of the United States (New York, Boston, Philadelphia, New Haven and Baltimore) and five in Canada (Montreal and Toronto). The well-merited popularity of the work, of which the present edition contains a sympathetic preface by one whom Osler would have called his "brother Regius", is shown by the fact that three impressions were made of the first and nine of the second edition.

Though addressed primarily to medical practitioners and students, the work, owing to its cosmopolitan outlook, will appeal to a much wider circle of readers, especially at the present time. With a characteristic blend of ripe wisdom and playfulness, Osler discusses a great variety of subjects, such as the education of the medical student and post-graduate, the importance of foreign travel and avoidance of Chauvinism, the necessity of doing the day's work well and before the age of forty, and physic and physicians as depicted in Plato. A 'bedside library' of books for medical students is appended, consisting of the Old and New Testament, Shakespeare, Montaigne, Plutarch's Lives, Marcus Aurelius, Epictetus, "Religio Medici", "Don Quixote", Emerson and Oliver Wendell Holmes' "Breakfast-Table Series".

A Bibliography of the Writings of Harvey Cushing Prepared on the occasion of his Seventieth Birthday, April 8, 1939, by the Harvey Cushing Society. Pp. xv+108. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1939.) 5 dollars.

THIS book, the sale of which is limited to four hundred copies, contains the bibliography of a man who was equally well known as an eminent brain surgeon and the author of one of the most successful biographies of recent times. The work, which is preceded by a sympathetic and humorous note by Dr. Arnold Klebs, the well-known medical historian, entitled "Bibliographia Animata", consists of four parts and appendixes. The first part gives a short account of Dr. Cushing's life, degrees and honours bestowed upon him by more than twenty different nations. In the second part are listed his books, thirteen in number, of which the best known are "The Pituitary Body and its Disorders" (1912), the "Life of Sir William Osler" (1925), and "Intracranial Tumours" (1932), of which a German translation appeared in 1935 and a French one in 1937. The third part contains a list of his addresses, papers in journals, and reports published between 1898 and 1938 numbering 306, while the fourth part is devoted to papers emanating from Dr. Cushing's clinics and laboratories.

The appendixes contain the names of his assistants in neurological surgery from 1908 to 1932 and voluntary graduate assistants from 1920 to 1932, hailing from England, France, Germany, Belgium, Holland, Rumania and Esthonia, and a list of members of the Harvey Cushing Society.

German–English Science Dictionary
For Students in the Agricultural, Biological and Physical Sciences. By Prof. Louis de Vries, with the collaboration of Members of the Graduate Faculty. Pp. x+473. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18*s.* net.

IT was Dr. Samuel Johnson who emphasized our indebtedness to the compilers of dictionaries when he wrote, "Every other author may aspire to praise, the lexicographer can only hope to escape reproach". Scientific men will indeed be grateful to Prof. de Vries for having brought together some half a million stock words which are representative of German scientific language. No attempt has been made to include all the names of animals, plants, chemical compounds, etc., since each subject would need a dictionary of its own. But since research in the various departments of science now extends into complicated inter-departmental problems, the author has included terms which enter into the chemical, physical and biological sciences. Further selection has made use of the fact that the compounding of words is such a characteristic feature of the German language, only sufficient basic information being included to permit of the building-up of composite words. The book is strongly and attractively bound, but still remains a very convenient size for purposes of frequent reference. T. H. H.

PHYSICS

Cosmic Machinery in an Electro-Magnetic Universe By Capt. H. A. Staples. Pp. vi+224. (London: William Clowes and Sons, Ltd., 1939.) 12*s.* 6*d.*

THE author of this work claims to have constructed a magnetic machine which was able to produce motion 'similar to the motion of the solar and planetary bodies". As the sun rotates, its field of radiation rotates with it, and this "solar sweep" is responsible for the forward motion of the earth in its orbit. Capt. Staples states on page 139 that, with reference to Kepler's Third Law, "the reason for the application of the power of the cube in association with the power of the square have [sic] remained obscure". Apparently, however, this obscurity disappears with his electromagnetic interpretation, planetary motions falling into line with the laws relating to wave motion issuing from a radiant source. It is only necessary to point out that there is nothing obscure about Kepler's Third Law, which is very easily derived from the inverse square law. It may be added that the electromagnetic field of the planets appears to play an important part in their orbital motion, according to the author, but he makes no attempt in this book to apply his theory to other bodies of the solar system, such as meteor streams, comets, or even the minor planets. Quantitative results on the motions of the satellites would have been useful to verify or disprove the theory, but the figures and explanations given on pp. 149–51 are too vague to be applied.

Although the author has spent twenty years of research on his work, it will not yet be generally accepted. M. D.

Spontaneous Fluctuations of Voltage due to Brownian Motions of Electricity, Shot Effect and Kindred Phenomena
By E. B. Moullin. (Oxford Engineering Science Series.) Pp. viii+252. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 17*s.* 6*d.* net.

TO an engineer the result of the spontaneous fluctuation of voltage is a noise which is getting in his way, and which he calculates from formulæ which give approximately the result he requires; he knows that he is up against a natural limitation of what he wants to do. The author of the volume now under review takes a novel view; he rather startles the engineer by making the subject of philosophical interest, and by showing that the physicist does not know as much about the subject as the engineer thought he did. The author does not think that theory has caught up with the abundant experimental data, and he has done a remarkable service in collecting such information as is available in a readable way, so that some super-mathematician may be inspired to find a link between atomic data and the nuisance being examined.

The text is produced with the care and clarity we have been led to expect from the Oxford Engineering Science Series. L. E. C. H.

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to deterioration at a rate almost unknown in temperate latitudes. A single rainy season can completely destroy the fertility of a tropical soil unwisely exposed.

Soil Destruction in Malaya

The damage done to agricultural land by various forms of mining is considered by Sir Lewis L. Fermor in his exhaustive "Report upon the Mining Industry of Malaya" (Kuala Lumpor : Gov. Press, 1939. 6*s*.). The destruction of land by the stacking of waste rock and gangue is small because the prevalent forms of tin-mining result in floods of water, heavily charged with silt, either as coarse as sand or as fine as mud. This silt, carried by the effluent water, chokes streams and causes flooding to such an extent that silt-retention schemes, necessitating dams or weirs, are obligatory. But much damage has been done in the past, and some is still being done, especially in the mining process of destroying hillside by water under hydraulic pressure. Again, the removal of the top layers of soil and their mixing with lower layers, which is unavoidable in the process known as dredging, render the whole surface within a mining concession unfertile by the time the land is returned to agricultural use. Against these objections to mining must be placed the fertilizing value on flooded land of a thin deposit of silt. The writer is insistent that rubber cultivation is equally harmful, in fact more so, in ruining land by encouraging soil erosion and leading to the removal of fertile surface layers. Clean weeding, a fetish of the rubber planter, causes soil removal between the rows of trees, and can be prevented only by the wise use of cover crops. Sir Lewis estimates that rubber cultivation has caused the addition of 33,000,000 tons of silt to the river systems since 1905, while tin-mining has contributed only 16,000,000 tons. The debris from the rubber lands is both coarse and fine, and does more harm than the fine silt from the mines, some of which is carried to sea, and some of which fertilizes the land.

Newton's Letters

In *Osiris* (7, 523–555 ; 1939) M. Jean Pelseneer, whose interest in the subject is well known, has reproduced some nine letters from Newton's unpublished correspondence. Four documents are shown in reduced facsimile, and all are accompanied by explanatory notes. The first four letters, between Newton and Oldenburg, are taken from the Portsmouth Collection in the University Library, Cambridge. The next two, between Newton and Hooke, are in the Library of the Historical Society of Pennsylvania at Philadelphia. Of all these the main theme is optical. Two other letters between Newton and Hooke come from the Pierpont Morgan Library in New York ; their subject-matter is of very minor interest. For the period covered by these eight letters (1672–78) little original material bearing on Newton's life has been published. The ninth document is a joint report signed by Newton and Halley on the performance of a magnetic needle. This is an official paper dated 1712, and preserved in the Public Record Office. It is two years since M. Pelseneer, writing in *Ciel et Terre*, pointed out with a reference to Stukeley's Memoirs of Sir Isaac Newton's Life, edited by A. H. White and then lately published, that the story of Newton and the apple certainly did not originate in the fertile imagination of Voltaire.

Early History of Antarctic Exploration

The criticisms levelled by Prof. W. H. Hobbs at certain English explorers of West Antarctica of the early part of last century (*Trans. Amer. Phil. Soc.*, **31**, Part 1, Jan. 1939) were discussed in Nature of April 29, 1939, p. 731. A much fuller and a most scholarly treatment by Mr. A. R. Hinks of Prof. Hobbs's strictures appears in the *Geographical Journal* of October under the heading "On Some Misrepresentations of Antarctic History". The title indicates the nature of the conclusions which Mr. Hinks reaches. From a study of relevant documents, including original maps, he shows conclusively that Prof. Hobbs's claim that Palmer and not Bransfield discovered the Antarctic continent is false and that there is no foundation for Prof. Hobbs's contention that the chart signed by Bransfield which is in the Hydrographic Office is not genuine, and that Prof. Hobbs has no justification for discarding the account of Bransfield's voyage which appeared in the *Literary Gazette* (vol. 5, November 1821). No argument that Prof. Hobbs brings to this discussion can shake the authenticity of the documents on which Bransfield's claim to the discovery of Trinity Land, the first sighting of the Antarctic continent, is founded. Mr. Hinks raises many other points in his articles, including Prof. Hobbs's aspersions on the good faith of J. Weddell, whose discoveries conclusively stand the test of any inquiry and criticism. The article may be accepted as a final reasoned answer to the attacks made by Prof. Hobbs on these English navigators of Antarctic seas.

Germany's Oil Supplies

In a carefully reasoned article published in the November issue of the *Industrial Chemist*, Dr. A. J. V. Underwood explains why in his opinion it is unlikely that Germany's belligerent activities will be suspended owing to shortage of oil. The present rate of production of oil and alternative fuels in the German Reich is estimated as 4,300,000 tons. This figure includes potential production of plants expected to be in operation by the end of this year. If plants which are likely to be in production by the end of 1940 or beginning of 1941 are included in the estimate, the potential rate of production of oil from all sources becomes 6,550,000 tons per year. In addition, imports of oil are at present available to Germany from Estonia, Rumania and the U.S.S.R. These with home-produced oil bring her total resources to 7,000,000 tons a year. If home production is increased as is anticipated, Germany will have access to 9,300,000 tons of oil a year. In 1938 Germany, including Czechoslovakia, consumed 7,900,000 tons of oil. This is substantially less than the 9,300,000 tons per annum poten-

tially available, but has reference to peace-time conditions. In war-time, consumption by the fighting services will obviously increase even beyond the figure for 1938 when Germany was mobilizing, but at the same time civilian consumption will drop on account of the stringent rationing schemes now in force; also less oil will be used by Germany's mercantile marine, the activities of which have been so severely restricted of late. It is probable, therefore, that Germany's potential resources of oil will be sufficient for her war-time needs, and as reserves are available to supplement home production until such time as all projected plants are in operation, it is unlikely that she will go short of oil, unless through drastic changes in the international situation.

Folsom Man: Further Investigation in Colorado

A further season of excavation on the Lindenmeier site in northern Colorado has again failed to produce any trace of skeletal remains of Folsom man. Until such evidence is forthcoming, and on the assumption that it will afford some certain indication of the relation of the authors of the culture to the Amerindian peoples, the Folsom industry, with its distinctive characteristics, hangs in the air. The geological interpretation of the Folsom deposits on the Lindenmeier site assigns them to the last phase of the glacial period at an approximate dating of 12,000–25,000 years ago, and an association with an extinct fauna including mammoth, camel and extinct forms of bison. In the course of excavations carried out by Dr. F. H. H. Roberts, jun., in the past summer, the fifth season of his investigations on the site, it is reported in a statement issued by the Smithsonian Institution of Washington, that among animal bones, which had been chopped and split by man, was found the skull of an extinct bison measuring 36 inches between the tips of the horn cores—fully a foot wider than the spread between the horns in the modern species. In four months' work Dr. Roberts opened up a new section of the site over an area of some 45 ft. by 60 ft. to an average depth of six feet. His finds, in addition to the characteristic projectile points and previously known artefacts, included new forms of knives and scrapers, two to three times as large as those found before. A new feature in the culture is the bone bead, not hitherto found in Folsom deposits. Of those found here, one shows definite ornamentation in the form of a simple geometric design scratched on the surface.

Mental Hygiene in Old Age

In a paper on this subject read before the Section on Care of the Aged, Welfare Council, New York City (*Mental Health*, **23**, 257; 1939), Dr. George Lawton, psychological adviser to the Andrew Freedman Home, New York City, maintains that there is no group of persons whose mental welfare is more neglected than that of old people. This indifference, he declares, is world-wide even in countries with advanced social services. Although there has been for many years a guidance clinic for the aged in San Francisco, no definite steps have been taken for establishing a similar one in New York. Dr. Lawton asserts that what little knowledge we have of old people is based on pathological material, while we possess very little information about non-psychotic old persons. He suggests that the psychological difficulties presented by aged people should be classified as follows: (1) the problems of neurotic, borderline psychotic, psychotic, feeble-minded, and deterioriated individuals; (2) the minor mal-adjustments of fairly adequate old people caused by excessive economic pressures and inhibitory social attitudes; (3) the stresses and strains of persons undergoing normal mental and emotional decline. According to Dr. Lawton, the management of the problem of senescence should include the following measures, among others: (1) intensive, systematic studies over long periods of time, of the mental abilities, interests, recreations, emotions and personalities of larger groups of men and women in town and country in each decade from forty to sixty, (2) when such facts have been collected, guidance clinics should be set up to function in a similar manner to child guidance clinics; (3) courses in geriatrics should be established in the medical schools to give future physicians a better understanding of the effects of mental attitudes on the bodily ailments of the aged.

Wild-life Restoration in the United States

In the United States, as in other progressive countries, the existence of many wild creatures has been threatened by the appropriation of lands for farming and industrial purposes, the destruction of living places and breeding places, and the gradual disappearance of natural food and cover. To check this decrease of wild-life, the Federal Government passed two years ago one of the most beneficial measures of recent years, the Federal Aid to Wild-life Restoration Act, briefly known as the Pittman-Robertson Act of 1937. The co-operative scheme which it envisages is one that might well be adopted in other countries, and a summary of its provisions and explanation of the co-operation which it seeks are now given by Albert M. Day (*U.S. Dept. Agric. Misc. Pub.* No. 350; 1939). The Act recognizes the fundamental principle that wild-life is linked with the land, and aims at the restoration of suitable environment in which wild birds and mammals may live and multiply. The Federal Government is willing to contribute materially towards this restoration programme, since it is known that individual States have been unable to cope with the situation because of lack of funds. But a State to qualify for a share of the grant—up to 75 per cent of the cost of work performed on approved projects—must have passed laws for the conservation of wild-life, which shall include a prohibition against diverting fees paid by hunters to any other purpose than the administration of the State fish and game department. Already the Act appears to be working effectively. The grand total allocated for conservation projects in 1939 was 1,186,666 dollars, of which State legislatures

contributed 296,666 and the Federal Government 890,000 dollars. Some time must elapse before the effect of these widely distributed schemes shows itself on the wild-life population, but there is every reason to think that the result will be gratifying to the naturalist as well as to the sportsman.

Television Transmission over Telephone Cables

In the *Record* published in October by the Bell Telephone Laboratories, Inc., L. Weis gives a helpful discussion of the problem of transmission signals over telephone cables. Most radio broadcasts originate in the studios of the broadcasting companies, and are transmitted thence to the radio stations over high-quality programme circuits. Not infrequently the 'pick-up' point is at a distance from the studio and circuits to the studio must be provided over telephone 'cable pairs' not normally employed for broadcasting. With television broadcasts such remote pick-up points are also required, but the utilization of ordinary telephone circuits to link them to the television studio is more difficult because of the much wider band of frequencies employed, besides certain exacting requirements for television transmission. Because of the experimental state of television broadcasting at the present time, no arrangements for transmitting from these remote pick-up points have as yet been standardized.

Last May an experimental circuit of this nature was provided for the National Broadcasting Company. More recently a somewhat similar one was provided for the Columbia Broadcasting System. For ordinary telephone circuits a frequency band of about 3,000 cycles is sufficient, while for both these recent experiments the band extended from 45 to more than three million cycles—a range a thousand times greater than the voice band. When we consider the losses, we find that the loss in a co-axial cable at three million cycles is only one millionth that in a cable-pair of equal length. For satisfactory television transmission, equalizers must be provided to make the overall loss essentially the same for all frequencies. In addition to the variation in loss with frequency there is also a variation in the time of transmission. In television transmission, if this is not kept extremely small the detail of the picture will be blurred, and spurious transients and 'ghosts' will appear. Before a cable pair can be used for television, it is necessary to know the transmission time and then to provide phase equalizers to correct it. In the experiments the equalized line maintains the same transmission time to within plus or minus one tenth of a microsecond, and this can be measured.

Traffic Signals at 'Bank Complex'

A description is given in *Roads and Road Construction* of November 1 of the 'electromatic' vehicle-actuated system operating on the 'flexible-progressive' system. Automatic traffic signals outside the Bank of England and on several important roads in the locality are to be installed as early as possible. It has been found that the signals in other parts of the City have proved of such value during the black-out that police officers have been able to concentrate on other important duties, and it is only at a few intersections that it has been necessary for them to control traffic by hand signals. The name 'Bank Complex' has been given to the area which is the junction of Threadneedle Street, Cornhill, Lombard Street, King William Street, Princes Street, Queen Victoria Street, Poultry and Mansion House Street. A specification for traffic signals to control the heavy and complicated traffic at this junction was prepared by the Ministry of Transport in collaboration with traffic officials of the City of London Police.

A scheme to meet the requirements of the specification was prepared by Automatic Telephone and Electric Co., Ltd., using electromatic vehicle-actuated signals. As traffic is approximately equally heavy in all directions, the problem is mainly concerned with ensuring the most rapid transit of vehicles through the thoroughfares converging on the area of the Bank Complex. Traffic increases to a maximum at morning and evening periods, and, if congestion and traffic blocks are to be avoided, the available road space must be used with the greatest efficiency. The whole system will be 'electromatic', operating on the flexible progressive system, under the control of a 'dual master-timer', and vehicle detectors will be used in each approach to the 'Bank Complex'. Signals are actuated by a special control unit divided into seven sections, which are linked together to co-ordinate the signal phases. It is important to notice that right-of-way is given to an approach only if there is a demand, and the length of this right-of-way period depends, up to a predetermined maximum, on the volume of the traffic. A novel feature of this system is provision of accommodation for traffic assessors in Cornhill and Poultry to determine the volume of traffic entering the complex on these approaches, so that variations of the right-of-way time can be made automatically.

The International Seismological Summary

The International Seismological Summary for October, November and December 1933 has just been received. It deals with 123 epicentres for earthquakes which occurred during that quarter, of which 47 were new epicentres and 76 repetitions of earthquakes from old epicentres, thus again confirming the knowledge that earthquakes tend to recur from the same epicentres. The five earthquakes with abnormal focus during the quarter all had deep foci. The first was on October 25, with epicentre in the Andes north-west of Jujuy (Argentine) with focus 0·03 of the earth's radius below normal. The second was on November 14 with epicentre north-east of Santiago on the borders of Chile and the Argentine with focal depth 0·02 of the earth's radius below normal. The third was on November 19 in the Pacific Ocean off the Japanese coast nearly south of Tokyo with focal depth 0·035 of the earth's radius below normal. The fourth and deepest was on December 1 with epicentre in the Pacific Ocean immediately to the south of the island

of Aneityum (Loyalty Islands, Melanesia) with focus 0·09 of the earth's radius below normal. The fifth was on December 4 with epicentre in the Sea of Okhotsk to the east of Odomari with focus 0·040 of the earth's radius below normal. In continuation of the "Catalogue of Earthquakes 1925–1930", by Miss E. F. Bellamy, it has been decided to publish annually indexes to the International Seismological Summary. The first three of these for the years 1931, 1932 and 1933 arrived with the International Seismological Summary for the last quarter of 1933 and they form a very valuable addition to the summary for quick reference. The indexes are on a time basis, whereas Miss Bellamy's Catalogue 1913–1930 was on a geographical basis. The geographical basis is in many respects the better owing to the tendency mentioned above for earthquake shocks to recur from the same epicentre.

'Vibrated' Concrete

It is generally known that within certain limits the drier the concrete when it is mixed, the stronger it is when set. But it is not generally known, even among engineers, that it has been the practice for some years to contrive by mechanical means to produce super-compacted and hence super-strong concrete from materials which, treated in the normal way, would give normally strong results. A paper by R. F. Irving in the *House Journal of the Bournemouth Gas and Water Company* of October 2 gives the history and methods of manufacture of 'vibrated' concrete. In 1917, vibration of concrete was started in France on a commercial scale, and these machines have been extensively developed in America. Originally, the machines were driven by compressed air. The vibrating unit consisted of a freely moving piston, reciprocating as a shock producer, striking blows at a speed of 5,000–9,000 blows per minute. More modern machines, driven either by electric or petrol motors, have a rotor shaft provided with an unbalanced weight producing vibrations from 6,000 up to 21,000 per minute, the size of the motor unit varying from ¼ to 1¾ h.p. With the construction of No. 5 Reservoir at Alderney, the opportunity arose of taking advantage of the great developments in concrete construction. Preliminary tests of the relative strengths of unvibrated and vibrated concrete fully justified this procedure. Further, the vibration method led to a shortening of the time required for setting of the concrete and the consequent rapid release of the shuttering for use on new sections.

Earthquakes registered at Kew during October 1939

Fourteen earthquake shocks or earth tremors were registered on the seismographs at Kew during the month of October 1939. Four of these are reported to be very small, and some others have been confused by microseisms. The best seismograms obtained were for the earthquakes of October 10 and 17. That on October 10 had a probable epicentral distance of 88° from Kew and a depth of focus of 75 km. The earthquake of October 17 was again a deep focus shock, being thought provisionally from Kew records to have had a focal depth of about 150 km. It was probably situated in the New Hebrides and was strong enough to give a full complement of pulses, including *ipPPP*, a longitudinal body-wave reflected three times at the earth's surface, coming to the surface for the fourth time at Kew where it was registered.

Earth Tremor in New England

An earth tremor was felt on Tuesday night, November 14, in the New England States of Pennsylvania, New Jersey, Maryland and Delaware. The epicentre of the shock was probably very close to Philadelphia, and in Baltimore pictures were knocked off walls and furniture overturned, which indicates at this place a probable intensity of IV on the Rossi-Forel scale. Damage was not serious and there were no casualties. Although earth tremors are not unknown in New England, it is unusual to have one so strong as this. California and the western States are much more liable to shocks than the eastern States.

Earthquakes in Central America and Canada

Using instrumental reports from Georgetown, Fordham, Philadelphia, Weston and Guatemala, the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of September 20, 1939, to be between Corquin and Ocotepeque on the mountainous border between Honduras and Guatemala in Central America. From readings of seismograms obtained at Pittsburg, Tucson, Ottawa, St. Louis and Fordham, the provisional epicentre of the earthquake of October 23, 1939, has been determined to have been some twenty miles south-west of Tadoussac in the Province of Quebec. Both districts are liable to small earthquake shocks, though those in Central America are usually somewhat more intense than the Canadian shocks. Further news of these shocks is awaited from the observatories at Guatemala and Ottawa.

The Polarograph

Fifteen years ago Prof. J. Heyrovský, of the Charles University of Prague, described a polarographic apparatus with the dropping mercury cathode which he used for showing the presence of certain metals in solution by the position of 'waves' produced in the deposition potential curves automatically recorded as 'polarograms'. Since that time, Heyrovský and his co-workers have carried out many academic physico-chemical researches with the polarograph, and in recent years it was beginning to find application for other purposes in pure and applied science, ranging from its use in examining sera for the diagnosis of cancer (Nature, 142, 316; 1938) to, say, the estimation of iodine in Chile saltpetre. The genuine apparatus has hitherto been difficult to obtain, since it was only made in Czechoslovakia, and research workers and others will be interested to learn that although instruments are no longer obtainable from Czechoslovakia, an improved model, complete with

self-contained recording equipment, of British design, is now being manufactured by the Cambridge Instrument Co., Ltd.; it is anticipated that the polarograph will find still wider uses in the near future, especially in analytical and electrochemical work.

Petroleum

THE first number of *Petroleum*, a monthly magazine "devoted to the essential interests and needs of the petroleum industry", was published in October (Leonard Hill, Ltd., 17 Stratford Place, London, W.1. Annual subscription, 10*s*. post paid. Abroad, 12*s*. 6*d*.). The sponsors of this journal are to be congratulated on launching this new venture scarcely a month after the beginning of war, and on the way in which they have interpreted the Prime Minister's admonition to carry on. Naturally the outbreak of war materially upset carefully laid plans for the first number. Highly specialized articles had to be omitted and photographs discarded lest they should fall into enemy hands. Moreover, many potential contributors were called away on national service and were accordingly not in a position to submit articles. Nevertheless, in spite of these handicaps, the first number is full of interest and it may be its lack of too highly technical contributions will prove an asset in the long run. The question raised as to whether concrete or steel should be used for underground storage, the description of some lesser known uses of petroleum and the notes on petrol rationing in Great Britain and other countries, to cite a few examples, should appeal not only to petroleum technologists but equally to a far wider public.

Entomology in South Africa

THE appearance of volume 2 (dated October 30, 1939) of the *Journal of the Entomological Society of South Africa* will be welcomed by workers in this branch of zoology. Some seventeen papers are included within a compass of 262 pages and their great diversity of character may be gathered from the fact that they include descriptions of new Thysanoptera, a study of body temperature in *Samia cecropia* and an investigation of the chromosomes in some of the Transvaal Acrididæ. We wish every success to this new periodical and trust that it will be assured of adequate support during these critical times. The price of the volume is £2, and European readers may obtain it from N. V. Swets and Zeitlinger, Keizergracht 471, Amsterdam, Holland.

Books on Gardening and Botany

MESSRS. DULAU AND COMPANY, LTD., of 29 Dover Street, London, W.1, have issued a catalogue of books on botany and gardening. Several volumes of standard journals, many of which are out of print, are offered, notably *Curtis's Botanical Magazine* (1–42), the R.H.S. Daffodil Year Book for 1913–15, the first 22 volumes of the *Transactions of the Edinburgh Botanical Society*, the *Journal of Botany*, and the *Kew Bulletin*. The remainder of the list covers the better-known classics of a wide range of horticultural activities. Seventeenth-century herbals appear to be represented mostly by later reprints, though one or two originals are also offered. A number of first editions and association books of general literary significance occupy the main part of the catalogue.

Centenary of Pulkovo Observatory

THE centenary of the Pulkovo Observatory, one of the oldest scientific institutions in the U.S.S.R., will be marked by a special jubilee session of the Academy of Sciences to be held in Leningrad on December 25. The papers of a scientific and historical character to be read at the session will show in historic retrospect the century of endeavour of the Pulkovo Observatory and its role in world science. The centenary will also be marked by the issue of a comprehensive symposium and the opening of an exhibition dealing with the work at the Observatory.

Announcements

PROF. E. D. ADRIAN, professor of physiology in the University of Cambridge, has been appointed a member of the Medical Research Council in the vacancy caused by the death of Prof. John Mellanby.

THE following officers for 1940 of the Institute of Metals have recently been elected: *President*, Lieut.-Colonel the Hon. R. M. Preston; *Vice-Presidents*, Dr. S. F. Dorey, Engineer Vice-Admiral Sir George Preece, Mr. A. J. G. Smout; *Honorary Treasurer*, Lieutenant-General Sir J. Ronald E. Charles.

THE Institution of Automobile Engineers is holding a special general meeting to which other institutes have been invited on December 12, at the Institution of Electrical Engineers, Victoria Embankment, W.C.2, at 6 p.m., when Dr. J. S. Clarke of the City of Birmingham Gas Department will read a paper entitled "The Use of Gas as a Fuel for Motor Vehicles".

THE Hunterian collection of surgical specimens at the Royal College of Surgeons of England has been removed to a bomb-proof vault in the College basement. All the more important manuscripts, books, and pictures in the College library have been moved to the country.

The Universities of Breslau, Erlangen, Marburg and, with the exception of the medical faculty, Königsberg, which were closed at the beginning of the war, have reopened.

PROF. GERMANO SOLLAZZO has been nominated director of the new hospital at Milan named Ospedale del Perdono, which is to take the place of the famous old Ospedale Maggiore.

THE second Argentine Congress of Ophthalmology will be held at Rosario in October 1940, under the presidency of Prof. Esteban Adrogué. Further information can be obtained from the Sociedad Argentina de Oftalmologia, Santa Fé, 1,171.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 911.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

An Inhibitor of Growth Extracted from Pea Leaves

RECENTLY, Stewart, Bergren and Redemann[1] and Stewart[2] have extracted from the leafy cotyledons of radish seedlings a substance which retards the growth of oat coleoptiles. They extracted by a method devised by van Overbeek[3] for extracting auxin, leaving the material in purified ether without grinding it up, and then drying the extract by distillation and evaporation; and they tested the extract on decapitated coleoptiles by Went's method. Since it is an interesting question how widely growth inhibitors may be distributed in plants, I have made extracts from various parts of pea seedlings by the same method. The dried extracts were dissolved in a few drops of water, slightly acidified with hydrochloric acid, and the solutions, at about *p*H 5·5, were tested by being taken up in little strips of blotting-paper, measuring 8 mm. × 2·5 mm., which were then applied to *intact* dark-grown oat coleoptiles, lengthwise along one of the narrow sides and reaching to the top. The strips stood on little ledges of vaseline placed to support them. As a rule the dried extract from each gram of fresh plant material, weighing about 11 mgm., was dissolved in one drop (50 cmm.) of water, and each drop of solution sufficed for three strips of paper and so for three coleoptiles.

The extracts made from mature pea leaves together with 3 or 4 cm. of stem to each leaf caused the coleoptiles to curve positively, that is, towards the side to which they were applied, showing that they retarded growth on that side. The curves were quite strong after 1 hour or less at about 19° C., and they usually increased up to 1½ or 2 hours and then diminished and sometimes reversed. They varied surprisingly in amount, but often reached 20° and sometimes 25° or 30°. Other tests showed that the curves could not be due to the *p*H or to the osmotic value of the solutions, so that they must have been due to an inhibiting substance or substances. The curves started close to the extreme tip and spread downwards very slowly, reaching a level 10–12 mm. below the tip, and 2–4 mm. below the base of the strip of paper, after 2–3 hours. So this inhibiting substance differs from that obtained by Stewart and others, which travelled much faster. It is not the same as the wound substance, which had no effect in the same test. Extract from stem alone caused no curves, so that the inhibitor is presumably contained in the mature leaves. Extracts from growing apical buds caused only few positive curves, or sometimes none. But they often caused negative curves which developed later and at a lower level, and may possibly have been due to auxin. Extracts from correlatively inhibited leafy lateral shoots caused positive curves, indicating inhibitor.

These results suggest the question whether this inhibitor is involved in correlative inhibition. If so, it should disappear after several days from decapitated disbudded shoots: for in such shoots a lateral bud, if allowed to remain, grows out rapidly after about 3 days, showing that inhibition has practically ceased. But actually in some experiments (though not in all) the leaves of such decapitated shoots were found still to contain abundant inhibitor after from 4 to 8 days. However, this objection is perhaps not quite conclusive.

The inhibitor when contained in the dried extract was found to be insoluble in dry ether. So it must have diffused out from the etherized plant material in the water which was present: for a little water was, of course, introduced in the plant material itself, and also the ether used in the extraction was not quite dry. Accordingly, in order to collect the whole of the inhibitor, the distilling flask was rinsed out with 2 or 3 c.c. of water after the ether had been distilled off (at 60° C.): this water was added just before the distillation.

R. SNOW.

Magdalen College,
Oxford.
Nov. 4.

[1] Stewart, W., Bergren, W., and Redemann, C. E., *Science*, N.S., **89**, 185 (1939).
[2] Stewart, W., *Bot. Gaz.*, **101**, 91 (1939).
[3] Overbeek, J. van, *Proc. Nat. Acad. Sci.*, **24**, 42 (1938.)

Utilization of Carbohydrates in Leguminous Symbiosis

EXPERIMENTS carried out in this department during the past summer may be of interest in connexion with a recent letter from Allison and his collaborators[1] in which they conclude for field-grown leguminous plants that the associated nodule bacteria consume only a relatively small proportion of plant carbohydrates in their respiration. In these experiments, determinations have been made of the rate of evolution of respiratory carbon dioxide from the root systems of two series of soya bean plants growing in water culture (Crone's solution), one series (of fifteen plants) being nodulated, the other (of ten plants) being kept free of infection by the nodule organism and supplied with sodium nitrate. During the determinations, which were made at the flowering stage and at a temperature of 20°–21° C., air initially free of carbon dioxide was bubbled through the culture solution in which the root systems were growing and then passed into absorption towers containing standard baryta. For the nitrate plants the evolution of carbon dioxide was of the order of 0·8 c.c. (at N.T.P.) per hour per gm. dry weight of root tissues. Allison *et al.* report an average Q_{O_2} of 2·2 for detached root fragments, equivalent to an absorption of 2·2 c.c. of oxygen per hour per gm. dry weight. They used young roots only, whereas the figure of 0·8 c.c. is an average for the whole root system: again, it is

probable that the Washington experiments were conducted at a higher temperature.

From the results with the nodulated plants, it appears, assuming the respiration per gm. dry weight of the root tissues of these plants to be similar to that of the nitrate plants, that the evolution of carbon dioxide from the nodules themselves was of the order of 2·5 c.c. per hour per gm. dry weight.

In comparing this with the corresponding figure of 2·2 given by Allison *et al.* for oxygen absorption by nodules (detached), consideration must be given to possible differences of temperature and also to their finding that the respiratory quotient of nodules in air is considerably above unity. Since in the Glasgow experiments the dry weights of roots and of nodules were as 2·8 : 1 in the nodulated plants, it appears that during a given time the total carbon dioxide evolved from the nodules of a plant was slightly greater than that from the roots alone. If, as Allison and his co-workers conclude, the respiration of nodules is partly anaerobic, it is possible that in these particular plants the amount of carbohydrate utilized in nodule respiration (presumably chiefly by the bacteria) exceeded appreciably that used by the roots themselves, though no doubt it was still small compared with the total carbohydrate synthesized by the plant. The dry weight of roots and tops together compared with that of the nodules was as 12 : 1; but so far no figures have been obtained for the respiration of the aerial organs of plants of this type. The experiments will be continued.

G. Bond.

Botany Department,
University of Glasgow. Nov. 4.

[1] Allison, Ludwig, Hoover and Minor, Nature, **144**, 711 (1939).

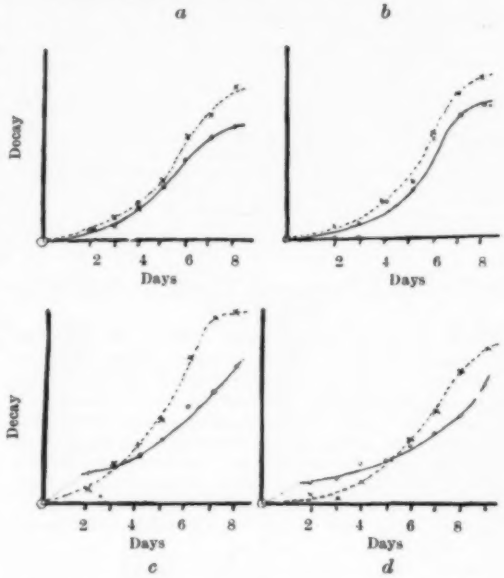
Humoral Immunity among Plants

Previous investigators[1,2] have concluded, after a number of attempts to produce some measure of humoral immunity in plants towards fungal and bacterial diseases, by various methods of 'vaccination', that there is no trustworthy evidence for any reported case of such immunity, despite earlier claims to the contrary[3,4]. Manil[5], however, reports a very localized and temporary immunity produced in tobacco by vaccination with *Bact. tabacum*.

The principal reason why plants cannot be expected to exhibit immunitary phenomena like those of the higher animals is due to their lack of a circulatory system, as pointed out by Chester[6]. For this reason, any immunitary humour which may be formed in a host cell attacked by a parasite will probably be destroyed on the death of this cell, unless it is able to move out by diffusion beforehand into living tissue; but in the course of this process, the humour will become so diluted that any immunitary effect observed will be quantitatively much smaller, and thus perhaps qualitatively different from those hitherto looked for.

In order to demonstrate such an effect, it would be necessary to carry out experiments designed to follow the course of development of the host-parasite complex, and to compare this with the course of development of a suitable set of controls.

Such experiments have been performed by me at this Station, using wheat seedlings as host plants, and the rusts *Puccinia graminis tritici* and *P. rubigo-vera tritici*na as parasites. Host leaves were inoculated in the usual way, and two or three days later severed from the plant and the rust destroyed by placing them in a water bath at 40° C. for 15 minutes. They were afterwards inoculated with either the same, or the other, rust species, and kept under observation in plugged test-tubes for up to 10 days. In control tests, either the first or the second inoculation was omitted, or both, but the warm-water treatment was given in every case; all possible combinations of the two rusts were used. All the host varieties used gave a fully susceptible reaction to both rusts.



Course of decay, observed (full line) and calculated (dotted line) in leaves cured of:

(*a*) *P. rubigo-vera* and re-inoculated with *P. graminis*:

(*b*) *P. graminis* and re-inoculated with *P. rubigo-vera*:

(*c*) *P. rubigo-vera*, and re-inoculated with the same;

(*d*) *P. graminis*, and re-inoculated with the same.

In all graphs, ordinates represent degree of decay on an arbitrary scale, and abscissæ represent days from the application of the curative treatment.

The course of decay of the experimental leaves was followed by noting the degree of decay (that is, flecking, chlorosis, sporulation, withering, etc.) on an arbitrary ten-point scale. Observations were made daily, and the results plotted as the whole-line curves on the accompanying graphs. These are shown alongside the dotted curves, which were calculated by adding the two corresponding curves for the single-inoculation controls. Each point represents the mean of from six to twenty observations.

It will be seen that whereas the curves of decay of leaves inoculated and cured of one rust, and re-inoculated with the other (*a* and *b*), were nearly the same, both in form and magnitude, as the calculated curve, those for leaves re-inoculated with the same rust (*c* and *d*) were both retarded and enhanced relative to the calculated curves, and did not begin to bend over sigmoidally like the others within the space of eight days from treatment. This suggests

that, whereas in the former case no appreciable interaction took place between the two dissimilar inoculations, in the latter the two like inoculations did so interact, and in view of the fact that the rust of the first inoculation was in every case completely destroyed by the curative treatment, this interaction was most probably due to the production of some specific humour by the first inoculated rust.

A full account of this work is to be published elsewhere in due course.

A. F. Parker-Rhodes.

Agricultural and Horticultural
Research Station,
Long Ashton, Bristol.
Oct. 7.

[1] Carbone, D., and Alexandri, E., *Bol. Soc. Ital. Soc. Int. Microbiol.*, 7, 221 (1935).
[2] Baldacci, E., *Nuov. Gi. Bot. Ital.*, **42**, 599 (1936).
[3] Frémont, T., *Ann. Inst. Past.*, **53**, 531 (1937).
[4] Carbone, D., and Kalajev, A., *Phytopath. Z.*, **5**, 85 (1932).
[5] Manil, P., *Mem. Acad. Roy. Belg. Cl. Sci.*, Sér. 2, **15** (1936).
[6] Chester, K. S., *Quart. Rev. Biol.*, **8**, 129 and 275 (1933).

Heterosis in Lycopersicum Crosses in Relation to Seed Weight

In a recent communication Ashby[1] has criticized certain conclusions which I have drawn from an experiment[2] dealing with the problem of heterosis in Lycopersicum crosses. It was shown in this experiment that, in general, there is little correspondence between the presence of heterosis, measured as increase in fresh weight, in the seed and in the mature hybrid 145 days after sowing, and various possible reasons for this were discussed. Ashby suggests that there is another possible explanation which has been overlooked, namely, that correlations between seed weight and 'final weight' had been destroyed by the process of transplantation which took place in the 47th day after sowing, and he produces evidence to support this possibility. This evidence is in itself of great interest, but I consider that it in no way invalidates my conclusions, for the following reasons:

(1) My published data show that any correlations which might have existed between seed weight and weight of plant had already disappeared before transplantation took place (r between seed weight and dry weight of plant on 29th day $= -0{\cdot}160 \pm 0{\cdot}236$). Evidently this lack of correlation must be due to causes other than transplantation.

(2) In spite of marked differences in growth-rate between certain lines there is still a significant correlation ($r = 0{\cdot}488 \pm 0{\cdot}160$) between the dry weight of the plants before transplanting (29th day) and fresh weight after transplanting (145th day), so that, in this experiment, correlations were not destroyed by the process of moving the plants from pots in the greenhouse to a bed in the garden.

The problem of the relationship between seed or embryo weight and the size of the plant after a given period of growth is evidently a complex one, the full elucidation of which must await the accumulation of further experimental evidence. Investigations along these lines are at present in progress.

L. C. Luckwill.

Department of Botany,
University,
Manchester. Oct. 26.

[1] Ashby, E., Nature, **144**, 712 (1939).
[2] Luckwill, L. C., *J. Gen.*, **37**, 421 (1939).

A Light-sensitive Strain of *Pseudomonas aeruginosa*

A strain of *Pseudomonas aeruginosa* (*Bact. pyocyaneum*), isolated from a milk factory effluent, was found to be affected by daylight in two different ways. In the first place, the formation of pyocyanin in young cultures was diminished in daylight. Cultures on a glycerol-peptone agar[1], grown at room temperature in the dark, developed an intense blue colour in two weeks (Ridgway's Dark Delft Blue[2]), while parallel cultures in a north window showed a transient green colour (Russian Green) one week after inoculation but had faded to a dirty green-brown by the second week. Growth was apparently equally good in both sets of cultures.

The second effect of light was to cause a marked acceleration in the appearance of a red-brown colour in old cultures. *Ps. aeruginosa* cultures kept continuously in the dark undergo an almost imperceptible and very slow colour change from dark blue through plum colour to dark brown, which takes about eight weeks to complete at 20° C. But dark-grown fortnight-old blue cultures changed to dull brown in a week, and to bright red-brown (Russet) in a fortnight, when kept in a north window. This rapid change of colour in daylight was also observed in cultures killed with formalin.

The view that the red-brown pigment in old cultures of *Ps. aeruginosa* is an oxidation product of pyocyanin[3] is supported by the fact that, when blue cultures were exposed to daylight inside an anaerobic chamber, fading was seen, but no change to red-brown was visible in two weeks.

The red-brown pigment is therefore an oxidation product of pyocyanin; its formation is accelerated by daylight, and is independent of the presence of living bacteria.

Jane Meiklejohn.

Department of General Microbiology,
Rothamsted Experimental Station,
Harpenden. Nov. 3.

[1] Turfitt, G. E., *Biochem. J.*, **33**, 1323–8 (1936).
[2] Ridgway, R., "Color Standards" (Washington, D.C. (1912)).
[3] Sullivan, M. X., *J. Med. Res.*, **14**, 109–60 (1905).

Influence of Age upon the Requirement of Vitamin A

During the course of experiments in which rats were given graded amounts of vitamin A, it was noticed that by 50 days the incisor teeth of animals on daily doses of from ½ to 1 I.U. had lost the deep orange pigment in the enamel, the teeth of animals receiving larger doses being at this stage normal. But, if these latter rats were allowed to live longer, it was found that daily doses of 2–3 I.U. of vitamin A, which were adequate to produce normal teeth at 50 days, appeared insufficient when the animals were older, since later their teeth also gradually lost their pigment. It was therefore decided to investigate this point more closely and to examine the teeth histologically.

The changes in the rat's incisor tooth in vitamin A deficiency have been already described by Wolbach and Howe[1]. The earliest effect is upon the odontoblasts, which show irregular downgrowths into the dentin, leading ultimately to the complete disappearance of predentin. In advanced cases the odontoblasts show marked atrophic changes or disappear completely. This is particularly marked on the lingual side of the tooth, where in extreme cases the formation of dentin completely ceases and the odontoblasts are entirely lacking. As a result of the continued growth of dentin on the labial side, the pulp cavity is pushed

to one side of the tooth, and the pulpal slit at the distal end is displaced to the lingual side in a most striking manner. This inequality of dentin growth in vitamin A deficiency has also been noted by Schour, Smith and Hoffman[2]. Islets of osteoid tissue may be found in the pulp. In early stages the enamel organ appears relatively normal but later a progressive atrophy is seen. The epithelium becomes flatter and the epithelial papillæ shrink, and in extreme cases the entire structure is replaced by a fibrous band in which epithelial papillæ occur irregularly.

Groups of animals consisting of litter mates were put on our vitamin A-free diet (Irving and Richards[3]) at weaning (23 days) and given dosages of vitamin A varying from ½ to 3 I.U. daily. They were killed at different ages and their teeth examined. An arbitrary scale given in the accompanying table was employed for assessing the degree of histological abnormality found.

Degree of Severity of Changes in the Teeth of Rats on Varying Doses of Vitamin A.

Days on diet	Daily dose of Vitamin A (I.U.)						
	0	½	⅝	1	1½	2	3
28	0	—	—	—	—	—	—
38	1	—	—	—	—	—	—
42	2	—	—	—	—	—	—
49	2,2*	1	?1	0	0	0	0
52	2,1*	2	1	1	1	1	0
54	1	—	—	—	—	—	—
66	2	1	1	0	0	0	—
119	—	—	—	4	—	—	—
148	—	—	—	4	—	—	—
180	—	—	—	—	4	4,3*	1,1*

The severity of the lesions is indicated by a number according to the following scheme: 0, normal; 1, slight changes in the odontoblasts and dentin; 2, marked changes in the odontoblasts and dentin; 3, overformation of dentin on the labial side together with the previous changes; 4, atrophy of the enamel organ together with the previous changes. * Two animals.

In this experiment more particular notice was taken of the changes in tooth colour. It was found in general that by 66 days on the diet, the teeth of the negative controls were quite white and those of rats getting ½ and ⅝ I.U. were very pale yellow. On higher doses the colour became gradually deeper and the 3 I.U. dose gave teeth almost normal in appearance. When the animals were allowed to live longer, the teeth of rats on the higher dosages likewise faded in a progressive manner. After 105 days on the diet, the teeth of animals getting 1 and 1½ I.U. were quite white; after 135 days, those of rats getting 2 I.U. were completely colourless, and by 180 days those of rats getting 3 I.U. had only a faint yellow tinge.

The degree of histological change at different dosage levels and times is shown in the table. It will be noted that the negative controls showed the first abnormal signs after 38 days on the diet. The changes got worse with time but the animals died before very marked effects could occur, the longest survival on the vitamin A free diet being 66 days. In two groups of animals killed and examined after 49 and 66 days on the diet, slight changes were seen in rats on ½ and ⅝ I.U. daily, but the teeth of rats on the higher levels were normal. In a group killed at 52 days, the teeth showed changes up to an intake of 2 I.U. daily, 3 I.U. being adequate.

In comparison with these, a group of animals continued longer on the experiment showed very advanced changes in the teeth. Two rats each receiving 1 I.U. daily died after 119 and 148 days respectively and both showed extreme changes in the teeth. The other animals were killed after 180 days. Those getting 1½ and 2 I.U. daily showed very marked changes and even those getting 3 I.U. had teeth not entirely normal.

It should be noted that the time taken for the incisor tooth to be replaced by continual growth is about 40 days, so that the changes found in the teeth of all rats save the first listed occurred in teeth entirely formed while the animals were on the deficient diet.

The post-mortem findings in these animals followed in a striking manner the teeth changes. Of animals killed up to 66 days on the deficient diet, the negative controls showed the usual pathological changes such as keratosis of the stomach, and the improvement induced by even the smallest dose of vitamin A was very marked. Of the animals killed after 49 and 66 days on the diet, those getting 1 or more I.U. per day were quite free of pathological change; of those killed after 52 days, all showed some slight abnormality save the one getting 3 I.U. All the animals allowed to survive to later times had keratosis of the stomach, and several had this change in the bladder as well. This was most extreme in those getting 1 and 1½ I.U., was still present in marked amount in those getting 2 I.U. and was found in some degree even in those getting 3 I.U.

It appears from these results that the requirement of the animal for vitamin A increases with age, not only for tooth formation, but also to avert the other pathological changes associated with vitamin A deficiency. This is in somewhat surprising contrast with the requirements of other dietary factors, such as calcium and phosphorus, which are not supposed to increase in this manner. Guilbert and Hart[4] have suggested that the requirements of vitamin A are a function of the body weight, and our results would seem to confirm this.

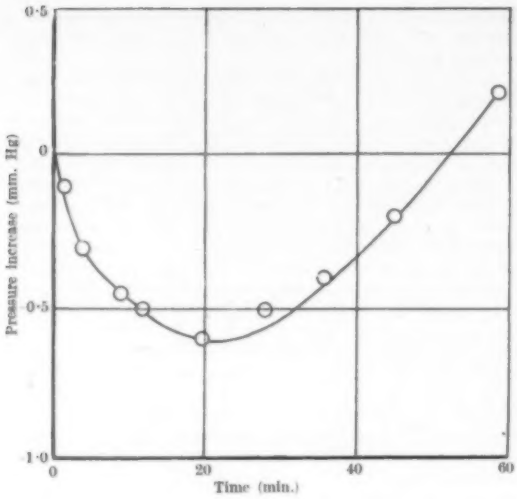
Rowett Research Institute, Aberdeen.
J. T. Irving.
M. B. Richards.

[1] Wolbach, S. B., and Howe, P. R., *J. Exp. Med.*, **42**, 753 (1925); *Amer. J. Path.*, **9**, 275 (1933).
[2] Schour, I., Smith, M. C., and Hoffman, M. M., *Proc. Soc. Exp. Biol.*, **39**, 447 (1938).
[3] Irving, J. T., and Richards, M. B., *J. Physiol.*, **94**, 307 (1938).
[4] Guilbert, H. R., and Hart, G. H., *J. Nutrit.*, **10**, 409 (1935).

Thermal Decomposition of Acetone

There has been much discussion and experiment about the question whether the thermal decomposition of various organic vapours under prescribed conditions occurs predominantly by way of free radicals or not. For the decomposition of acetone in a reaction of measurable rate in the neighbourhood of 500°–630°, all the existing evidence is against the radical mechanism, except that advanced by A. O. Allen[1], who found that on reducing the reaction temperature to 462° an 'induction period' was observable. He regarded this as evidence for the existence of chains which required time to develop.

Quite apart from the fact that the time taken to establish the stationary state in a radical chain reaction of the kind postulated for acetone would be expected to be immeasurably small, it seems that the experimental evidence may have a very different interpretation. The length of the 'induction period' corresponds to the time normally required for a fraction of one per cent only of the acetone to decompose: and any abnormal pressure changes during this time are in all probability due to secondary causes, since we find that instead of a simple delay in the pressure increase (the 'induction period') there may equally well be an actual *decrease* in pressure.



This is shown by the accompanying graph, which refers to an experiment with 300 mm. acetone in a 250 c.c. silica bulb at 460° C. Such a decrease cannot be due to a simple delay in the development of chains. It must be due to some cause such as an adsorption effect or to initial polymerization of ketene formed from the acetone. This possibility being recognized, the phenomenon observed by Allen, and in the modified form by ourselves, is too uncertain to weigh against other evidence, and on too small a scale to have influenced any of the rate determinations made at the higher temperatures.

J. G. Davoud.
Oxford. C. N. Hinshelwood.

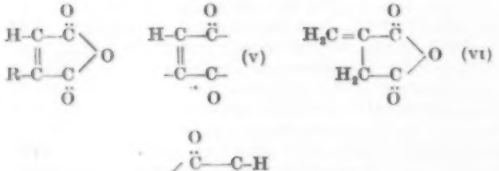
[1] *J. Amer. Chem. Soc.*, **58**, 1052 (1936).

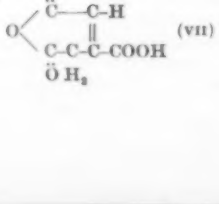
A Colour Reaction of Maleic Anhydride, *p*-Benzoquinone and their Partially Substituted Derivatives

When a trace of maleic anhydride (I) is added at room temperature to a colourless solution of triphenylphosphine (PPh_3) in chloroform or benzene (for example, 1 drop of 1 per cent maleic anhydride solution to 1 c.c. of a 1 per cent solution of triphenylphosphine), a permanent orange-red colour is produced immediately.

The same effect is observed with *mono*substituted derivatives of maleic anhydride, for example, citraconic (II), monochloromaleic (III), and *cis*-aconitic (IV) anhydrides:

R = H– (I), R = CH_3– (II), R = Cl– (III),
R = HOOC.CH_2– (IV. m.p. 74°)





On the other hand, no colour is developed with *di*substituted derivatives, for example, dimethyl-, diphenyl- and diacetoxy-maleic anhydride. Maleic acid, its dimethyl ester, succinic anhydride and *trans*-aconitic anhydride (VII. m.p. 134–135° C.) fail to give this reaction; but the phenomenon is shown by *p*-benzoquinone and those of its derivatives in which not all the hydrogen atoms are substituted, for example, 2 : 6-dichloroquinone and thymoquinone (2-methyl-5-*iso*propyl-*p*-benzoquinone).

It seems, so far as it could be ascertained, that this colour reaction is characteristic of the grouping (V) when forming a part of the above-mentioned ring systems. The observation that the solution of itaconic anhydride (VI) gave the colour reaction positive can be explained by the known fact that in solution it isomerizes to (II).

Amongst the various substances investigated which gave no colour reaction, we may mention anthraquinone, 2 : 3-dichloronaphthoquinone, phenanthraquinone and 2 : 6-dimethylpyrone.

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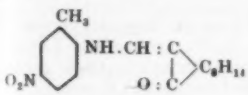
Difference in Odour of *d*-, *l*- and *dl*-Derivatives of Amino- and Bisamino-Methylenecamphors

It is well known that optically active isomers, despite the fact that they are identical in structure, differ from one another in those physical properties which are of the directional (vectorial) nature, such as, for example, direction of rotation of the plane of polarized light, unsymmetrical distribution of the hemihedral facets in their crystal forms, etc. The magnitude of these vectorial properties is, however, identical for the enantiomorphous forms. The optically active forms differ also in other respects, namely, in their action on micro-organisms, enzymes and in their physiological behaviour towards higher organisms. In 1886 Piutti[1] observed that *d*-asparagine had a sweet taste, whereas the naturally occurring *l*-asparagine was insipid. Cushny[2] found that *l*-hyoscyamine was twice as powerful in paralysing the vagus as the racemic form, atropine, while the *d*-form was twenty times weaker in this action. One of the most striking examples of different physiological activity recently observed is vitamin C or ascorbic acid[3]: the dextro-rotatory acid is active, the lævo-rotatory form being physiologically inactive.

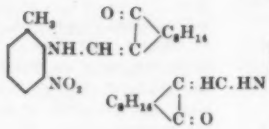
These differences in the physiological action of the optical antimers and their racemic forms are also associated with other properties, such as odour. J. von Braun[4] has observed a few cases in which he noted differences in odours not only among the optically active forms, but also in their inactive isomerides. The object of this communication is to record differences in the intensity of odour of several new derivatives of amino- and bisamino-methylenecamphors in their *d*-, *l*- and *dl*-forms. The odour was

Name of the compound	Order of intensity of odour	Number of observers
5.nitro-*o*-toluidinomethylenecamphors. (I)	*l*>*dl*>*d*	10
3.nitro-*o*-toluidinomethylenecamphors. (II)	*l*>*dl*>*d*	13
2 : 5-toluylene bisamino methylenecamphors. (III)	*l*>*dl*>*d*	11
2 : 3-toluylene bisamino methylenecamphors. (IV)	*l*>*dl*>*d*	11

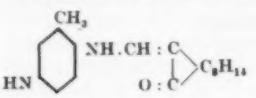
observed by different observers independently, and almost invariably the order of the intensity of odour as noticed by them was $l > dl > d$ in the four series of isomers. These results are summarized in the table above.



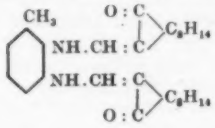
I



II



III



IV

The colour and odour of 3.nitro-*o*-toluidinomethylene-*dl*-camphor resemble those of saffron; the odours of the optically active isomers of this substance as well as of the remaining compounds in the table above have not been identified with that of any known substance. The odours are, however, pleasant.

The position of the nitro group in the nitro-*o*-toluidinomethylenecamphors has a marked effect on the intensity of their odours: the odours of these compounds, which are dyes with the nitro-group in the 3-position, are more intense than those of the corresponding forms with the nitro-group in the 5-position.

Several hypotheses have been put forward to account for the different physiological activities of the optically active compounds. Pasteur[5] explained such differences in action by supposing that the nerve-substances and the tissue-substances of the animals are themselves asymmetric. They therefore react differently towards the right- and left-handed forms of physiologically active isomerides.

Porter[6] was able to effect separation of racemic dyestuffs into their optically active components by differential adsorption of one of the isomers by wool. King[7], arguing from these observations, attributed the difference in the physiological action of optically active forms to physical rather than chemical causes.

A fuller account of this work will appear elsewhere.

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Sept. 24.

[1] Piutti, *C.R. Soc. biol.*, **103**, 137 (1886).
[2] Cushny, "Biological Relations of Optically Isomeric Substances", 39 (London: Baillière, Tindall and Cox, 1926).
[3] Demole, *Biochem. J.*, **23**, 770 (1934).
[4] Braun, *Ber.*, **56** (B), 2268 (1923); *Ber.*, **53**, 2210 (1925); *Ber.*, **60** (B), 2438 (1927).
[5] Pasteur, *C.R. Acad. Sci.*, **103**, 138 (1886).
[6] Porter and Ihrig, *J. Amer. Chem. Soc.*, **45**, 1990 (1923).
[7] King, *J. Chem. Soc.*, **125**, 46 (1924).

Points from Foregoing Letters

R. Snow has extracted from leaves of pea plants soaked in ether a water-soluble substance which inhibits the growth of oat coleoptiles.

By comparing the evolution of carbon dioxide from the root systems of nodulated and nodule-free, nitrate-fed soya bean plants growing in water culture, G. Bond concludes that the amount of carbon dioxide produced by the nodules of a plant of the former type was slightly greater than that from the roots alone. If, as other workers have concluded, the respiration of nodules is partly anaerobic in nature, then it is possible that in these water-culture plants the amount of carbohydrate utilized in nodule (presumably chiefly bacterial) respiration exceeded appreciably that used by the roots themselves.

A. F. Parker-Rhodes describes experiments from which it appears that some degree of acquired resistance can be demonstrated in wheat plants against two of the Puccinia rusts. This acquired resistance shows itself in an enhancement and a delay of the course of decay of cut leaves infected with the rusts, cured of their infection, and reinoculated, as compared with suitable controls. The magnitude of the effect is, however, small.

L. C. Luckwill observes that in a series of pure lines and F_1 hybrids of Lycopersicum correlation between seed weight and plant weight had disappeared by the 29th day, but points out that this lack of correlation was not due, as Ashby had suggested, to transplantation, because this did not take place until the 47th day.

Jane Meiklejohn describes a strain of *Pseudomonas aeruginosa* which forms less pyocyanin in daylight than in the dark. Light also accelerates the oxidation of pyocyanin to a red-brown pigment.

Small doses of vitamin A which are adequate to keep rats free from pathological change at early stages of the deficiency are not sufficient for this purpose as they grow older. It is inferred by J. T. Irving and M. B. Richards that the requirement of vitamin A increases with age.

The evidence, based upon certain abnormal pressure changes observed in the initial stages at low temperatures, that the thermal decomposition of acetone is a chain reaction is called in question by J. G. Davoud and C. N. Hinshelwood. Fresh evidence indicates that the effects are of a secondary nature.

A. Schönberg and A. F. A. Ismail describe a colour reaction between maleic anhydride and triphenylphosphine. The same effect is observed with mono- but not with di-substituted derivatives of maleic anhydride. The phenomenon is shown by *p*-benzoquinone and those of its derivatives in which not all the hydrogen atoms are substituted.

The intensity of odour of the optically active forms of several new derivatives of amino- and bisaminomethylenecamphors has been examined by Bawa Kartar Singh and Awadh Behari Lal. They find in each series that the lævo form has the most intense odour, followed by the racemic and dextro forms, in that order.

RESEARCH ITEMS

Early Islamic Decorative Technique

The first occasion on which it has been possible to analyse early Islamic niello is recorded in connexion with a group of objects in the precious metals said to have been dug up at Nihavand, a city of Persian Iraq, by Mr. Basil Gray (*Brit. Mus. Quarterly*, **13**, 3; 1939). The group in question has recently been acquired by the British Museum (Bloomsbury). Apart from its value as an addition to the collections, its importance is the greater because of the extreme scarcity of objects with precious metals from Islamic lands, where there are no tomb burials, and successive invasions caused widespread destruction. The find consisted of forty pieces, of which thirty-nine are of silver, nearly all enriched with gilding and niello, while one, the most considerable in size, is of gold. This latter is a wine bowl decorated with engraved roundels and an inscription in Arabic around the outside of the lip. Among the silver pieces are two series of plates which formerly decorated leather belts, two beads, a small circular plaque, a butt of a halberd possibly, and four other inscribed objects, as well as some fragments of buckles. The style unmistakably points to the Seljuk period. Epigraphic and stylistic evidence alike suggest the latter part of the twelfth century. Dr. Plenderleith reports after examination that there are microscopic particles of white metal embedded in the gold of the bowl; no iron is present and the particles are non-magnetic. They are extremely hard and there is good reason to regard them as iridium. Spectrographic examination of the niello indicates the presence of copper, silver, gold, tin, lead, with traces of aluminium, potassium, magnesium and boron. Analysis of filling taken from one of the small fragments of silver reveals the presence also of sulphur. The composition of this niello is, therefore, probably the same as Western niello, in antiquity according to Pliny, in the Renaissance period according to Cellini.

Cattle and Marriage among Southern Bantu

Among the Lovedu of the north-eastern Transvaal marriage, being patrilocal, involves, as among other Southern Bantu tribes, the transfer of *munywalo*. The nature of this institution has been analysed by J. D. Krige (*Africa*, **12**, 4; 1939), who points out that the various interpretations in which it is regarded as the legalization of marriage, as a guarantee of a wife's status or good behaviour, and in terms of compensation, economic or ritual, are in the nature of parodies. To discover the real place of *munywalo* in the social system, it is necessary to appreciate the relation of the cattle exchanges to the social structure, as cattle constitute the essence of *munywalo* and the exchanges are the most important use to which cattle are put. The people do not rely on cattle raising. Milk is not used at all; the meat of cattle which die is much appreciated as a relish; the skins are used or discarded indifferently. Ploughing has added to the uses of the cattle, but social values centre in agricultural productivity rather than the role of cattle in contributing to this result. Cattle constitute no great standard of the kind of affluence that is important, this being based on maize. It is hidden rather than displayed, and gives no man the privileges of rank. Yet like other Bantu tribes, the Lovedu have a strong emotional attachment to their cattle, though they are not regarded as sacred. Nevertheless, they are not sold or slaughtered, though there is no taboo against it. This is neither economic nor anti-economic, but *sui generis*. The chief function of cattle is in *nywalo* exchange, which accounts for more than 95 per cent of all transfers of cattle, the only other occasion being when judgment debts are paid. There are about 330 marriages each year, for which the theoretical minimum number of cattle needed is about 2,600—only 400 short of the total in the society. A distinction is drawn between cattle which have become involved in *munywalo* exchange and those which are unencumbered. Thus about 87 per cent of the cattle are held in a chain of rights and restrictions which the temporary owner cannot ignore. The exchange conditions, and is conditioned by, two main social arrangements, cross-cousin marriage, and the allocation of a sister's *munywalo* to her brother. Hence arise series of cattle linkages by which social groups, originally unrelated, are bound together in a close network of social interests and responsibilities.

Increased Mutation due to Hybridization

Hybridization leads to increased variability by the mechanical recombination of genes present in the parents, followed by segregation. A. H. Sturtevant (*Proc. Nat. Acad. Sci.*, 25, 308–310; 1939) has shown that inter-racial hybridization also may lead to an increased mutation rate. By crossing marked races *A* and *B* of *Drosophila pseudoobscura* and back-crossing to race *A* or race *B*, he found that about 8·5 per cent lethal and about 0·5 per cent sex-linked visible mutations were obtained. This is a much higher mutation frequency than usually found in intra-racial crosses, and has important implications regarding the evolution of new forms.

Development of Wings in Drosophila

C. H. Waddington (*Proc. Nat. Acad. Sci.*, 25, 299–307; 1939) has made a study of the development of the wings of normal and mutant Drosophila in order to investigate the times and modes of effect of different genes upon wing formation. The normal wing expands rapidly until about seventeen hours after pupation. At about twenty hours, contraction takes place from the periphery inwards, and some veins make their appearance first as broad bands which rapidly narrow. At about twenty-five hours the wing is a thin blade, and at forty hours the wing is fully formed and hairs appear. This definitive wing stage is followed by folding accompanied by a second expansion. At emergence, drying out of the wing leads to the second contraction and obliteration in the internal structures. The effects of twenty-four genes affecting the wings were studied. These relate to shape, size, vein breakage and additions, blisters and wing-curvature. The first visible effect of some is seen in the prepupal stage (*dy* and *m*), while the visible effect of others is not seen until unfolding in the young imago.

The Oriental Peach Moth in Australia

The oriental peach moth (*Cydia molesta*) has caused serious damage to the fruit industry of the Goulburn Valley, Victoria, during the past few years. Infestations which had occurred in this region for many years had been attributed to the codling moth (*Cydia pomonella*) whereas, in so far as peaches are concerned, the most damage was caused by *C. molesta*. The degree of infestation varies seasonally, and in 1933–34 this insect caused damage to orchardists amounting to about £70,000. The losses are sufficiently serious to threaten the canning industry and to call for a thorough study of the problem. G. A. H. Helson, of the Commonwealth Division of Economic Entomology, gives an account of the problem in Pamphlet No. 88 (1939) of the Council of Scientific and Industrial Research for Australia. It appears that little good can be expected from spraying as a method of control, and this has caused more attention to be concentrated on biological means of repression. Nine species of parasites are known to be primary agents attacking the insect in Australia. Of these the chalcid wasp *Dibrachys boucheanus* is the most effective: it parasitizes larvæ up to ninety per cent at the latter end of the season. Since this is not sufficient to ensure an economic degree of control of the oriental peach moth, it was considered that the introduction of parasites attacking the spring and summer generations of this insect might prove advantageous. The result has been that four species of larval parasites and one species of egg parasite were introduced into Australia during 1935–38. Recoveries made in the field show that the Braconid *Macrocentrus ancylivorus* is the most promising of these parasites, and it is proposed to make further introductions of this insect.

Antirrhinum Rust

A rust disease of the antirrhinum made a lightning descent upon Great Britain in 1934, but has not since troubled our gardens. The causal fungus, *Puccinia Antirrhini*, appeared in Egypt in 1936, however, and as it has since occurred rather frequently, Dr. Amin Fikry has made a study of the malady and its control (*Min. Agric. Egypt, Tech. and Sci. Service Bull.*, No. 223. Govt. Press, Bulaq, Cairo, 1939. P.T.4). Many interesting features of the disease which were not apparent in the temperate climate of Great Britain are described for Egypt. Applications of various sulphur fungicides made at intervals of two or three weeks, for example, can control the disease most effectively, and it appears that the beneficial effect of this treatment is dependent upon a temperature higher than 22° C. All varieties grown in Egypt appear to be susceptible to the disease, and teleutosori have even been found on the roots of some plants. Larvæ of species of Cecidomyidæ were obtained from the rust pustules, but do not appear to diminish the effects of the fungus. Several plates illustrate this account of the disease, which also contains good descriptions of the various symptoms, and a short summary of previous knowledge about the malady.

Apple Canker

The canker disease of apple trees is still a very serious malady. It is caused by the fungus *Nectria galligena*, and though it has been controlled to a large extent by correct pruning, present-day knowledge of the disease is not very detailed. Two recent papers in the *Annals of Applied Biology* (**26**, No. 3, August, 1939) describe investigations into the discharge and determination of spores (by R. G. Munson, pp. 440–457), and into the incidence and control of shoot infections (by R. W. Marsh, pp. 458–469). Perithecia are formed in the cankers, and the ascospores are forcibly ejected throughout the year, when atmospheric humidity is sufficiently high. Ascospore discharge is at a minimum in summer, however, but attains a maximum in January and February. Conidia are liberated during the wet periods in spring and autumn, and germination of both kinds of spore can take place between 2° C. and 30° C. The fungus therefore appears to be well equipped for parasitism, so far as its reproductive bodies are concerned.

Recent Volcanic Activity in Japan

According to H. Tanakadate, volcanic activity in Japan during the period November 1935–December 1938 (*Jap. J. Astro. and Geophys.*, **16**, Nos. 2–3, 93–121; 1939 Tokyo) may be divided into four groups: (1) Secondary phenomena having no direct connexion with deep-seated magma; (2) the Volcanian type of explosive eruption; (3) the Strombolian type of eruption; (4) the formation of a new volcano. Of the latter there were two: (*a*) Taketomi islet near Alaid Island (1934), which was of the homate type, and (*b*) Iōzima–Sintō, south of Kyūsyū (1934–36), which was of the tholoid type. What may be regarded as a typical volcano-tectonic earthquake occurred in part of the Kuttyaro Caldera, which is one of the largest in the world and noted for its sulphur production, on May 29, 1938, at 1.42 a.m. The top surfaces of both domes of Noboriondo and Maruyama fractured in the direction of the chain (N. 60° W.), the dormant fumerole on the northern side of the Oakots became active and the lake coast of the region rose about one metre in the north. It is believed that the earthquake was caused by movement of lava still in the molten state in the deep-seated root of the three domes. The most active volcano in Japan is that of Asama-yama, which is subject to frequent explosive eruptions of the Volcanian type. In the volcano observatory at Mine-no-Tyaya, 4 km. east of the crater, constant observations are carried out with seismographs, tiltmeters, earth current meters, magnetometers and other instruments. According to Minakami, the accumulation of ejectamenta on the crater rim reached 18 m. thickness from 1917–35.

The Goose Lake Siderite

Prof. F. C. Leonard has a short account of this siderite in *Popular Astronomy* (**47**, 6; June–July, 1939). It was discovered on October 13, 1938, was removed a year later, and is now the property of the Smithsonian Institution and the United States National Museum. Its weight is 2,573 lb. (1,167 kgm.), and on etching the polished surface of a small fragment with dilute nitric acid, the characteristic Widmanstätten figures were seen, indicating that the specimen is a medium octahedrite. As all the original fusion crust is missing, it is thought that the meteorite is a very old fall. When the body was found about two miles west of the western shore of Goose Lake, it rested in the centre of a saucer-like depression about five feet in diameter and one foot deep. It is considered to be the fifth largest meteorite known to have fallen in the United States and the third largest on record for the three Pacific Coast States.

FUNCTION OF THE ELECTRICAL SUPPLY ENGINEER IN WARTIME

IN the War of 1914–18 the supply engineer put to the service of the State his knowledge of the habits and business of those who lived and worked within his area of supply, not only as an individual but also backed by all the resources of his undertaking. Faced to-day with a similar crisis, Mr. J. W. Beauchamp, of the Central Electricity Board, recalls in an article published in *Electrical Industries* of November, what the supply engineer did during 1914–18. His main object was to assist the Ministry of Munitions and the Coal Control by pooling stocks, giving help in repairing damage or speeding up power supplies and dealing with the more difficult problem at that time of retaining skilled staff. All these were the subject of collective action.

The work was done with few formal meetings, but a large amount of personal effort and attention was given on the part of the staff. To-day the maintenance of supply and safety of the staff offers a much greater preoccupation. There is little time for discussion or inclination to go far from one's base, but the industry possesses a central development organization uniting all together, and able to pool ideas and unify action. The Commissioners and the Central Board in their respective spheres have formed a bond between the undertakings, and the Ministry of Supply itself includes the first chairman of the Central Electricity Board, a man whose work has left a great mark on the electrical industry of Great Britain.

Although reticence has become a virtue, few can fail to realize the great difference now governing the supply of lighting material and those which had to be met and remedied in the early years of the last war. Great factories created solely for defence can be supplemented by many but little smaller, which can be quickly turned from their peace-time activity to the production of the commodities required to keep a fighting force in action and make up its wastage. Much of the remarkable improvisation of 1914–18 can be avoided, but if and when it becomes desirable to enlist still more and perhaps smaller industrialists, it should be easy for authority again to utilize the local knowledge of the supply engineers and their staffs. In most cases they have the entrée to works of every kind in their areas and the confidence of the owners, and can often without delay suggest sources of supply and existing plant and labour easy to adapt to the mass production of simple items or components for use by more specialized manufacturers. The parcelling out of such work is not without benefit as it stimulates local interest, holds together business valuable in peace-time, reduces dislocation of local labour and trade, bringing with it opportunities of training unskilled persons, and as has often happened in the past, introduces into local works methods of production and degrees of accuracy which prove of value when normal labour is resumed.

In 1914 we had no experience of a contest between highly mechanized States. A thousand devices of attack and defence had been as yet unborn. Above all, there is the air menace which makes frontiers a plane rather than a line. In the electrical industry, the interval covers many changes, notably great collective control, administration by the Commissioners, operation by the Board, development and research by associations, and a close co-operation amongst those who produce and instal electrical appliances.

The outlook of the public towards electricity is now quite different. To-day all branches of the industry in combination provide the greatest public utility in the modern State, and the one in which the operators and their staffs have the most direct and frequent contact with the millions who use electricity for personal service or as a component in their trade or industry.

TRIBAL ORIGINS AND CULTURE AMONG THE FOX INDIANS

AN ethnographical account of the Fox Indians has recently been issued by the Smithsonian Institution. It has been edited by Margaret Welpley Fisher, and is based upon material which has an exceptional claim to authority. The author, William Jones, was born on the Sauk and Fox Reservation in Oklahoma in 1871. His mother was English, but his father was the son of a white man and an Indian mother. Up to the age of nine years, Jones was reared by his Indian grandmother, living the life of an Indian boy. On her death and after a period as a cowboy, he entered the Hampton Institute, passed to Andover and Harvard, taking the degree of M.A. at the latter in 1900 and Ph.D. in 1904. His intention had been to study medicine; but under the influence of the late Prof. Putnam he turned to anthropology, spending his vacations in field work among Algonquian tribes and making a comparative study of Algonquian religions. This field, however, afforded little hope of a career in research; and in 1906 the Field Museum offered him the choice of three expeditions, of which he elected for an expedition to the Philippine Islands. In the spring of 1909 he was murdered by the Ilongots.

Before his departure for the Philippines, Jones had already published some of the material he had collected in the field, while other studies were issued posthumously. The greater part of his papers, however, and that containing what now appears to have been the more valuable results of his inquiries, was missing. Its whereabouts was unknown until, on the

* Ethnography of the Fox Indians. By William Jones, edited by Margaret Welpley Fisher. (Bureau of American Ethnology, Bull. 125.) Pp. iv+156. (Washington, D.C.: Smithsonian Institution, 1939.)

death of his father a few years ago, it was disclosed by the family lawyer, who forwarded the papers to the Smithsonian Institution, that the father of William Jones had kept the existence of these papers a secret, as he had felt that much of the information divulged to his son had been due to his own friendship with the Foxes and, therefore, had been unwilling that it should be published during his lifetime.

A sealed packet said to have contained an account of "ancient mysteries" never previously revealed to a white man, to which reference is made in "William Jones" by Henry Rideout, has not yet been identified with certainty, although its existence has been confirmed by inquiry. Certain passages in the present account are indicated tentatively as possibly embodying this material.

The Fox Indians are of particular interest as culturally intermediate between the tribes of the eastern woodlands and those of the Great Plains. Their language is the most archaic of the Algonquian tongues; and with the Mexican Kickapoo, their kindred, they rank among the most conservative of all Indians. Hence until a few years ago, they were regarded as representing in their culture an archaic Fox pattern, and considered types of the "Central Algonquian". Examination of their history has weakened this view and indicates that there is no means of knowing how far it represents the truth. Acculturation has been carried to such lengths that it would be remarkable if many specifically Fox traits remained.

Knowledge of Fox history begins in 1640, when the Huron map was drawn up for the Jesuits. They had then been driven westward by hostile tribes, with whom they continued in conflict until the arrival of French traders in 1665. From that time onward, the French waged a war of extermination against the Foxes, whose country on the Fox-Wisconsin waterway was a preferred route to the Mississippi and a strategic point for trade. Failure to secure their adhesion to a French scheme of pacification of Indian tribes with Detroit as the concentration point embittered a struggle which culminated in the virtual extinction of the Foxes in 1728, when they were intercepted while trying to escape into Iroquois country. After a conflict lasting twenty-three days, only some fifty or sixty got away alive, or as it was expressed afterwards by a member of the tribe, in speaking of the wars with the French, "once there were only 3 lodges of the Fox Indians left".

However, in the winter following the massacre, the membership of the Fox tribe had risen again to 250. This and previous regenerations of the tribe had been effected in two ways. Prisoners were captured in war for the purpose of adoption into the tribe—the Pawnees, in particular, had been the victims of such attacks; and through the good offices of western allied tribes, Foxes who were held prisoners by hostile tribes were released and allowed to return to augment the tribe. These two elements, though politically all members of the Fox tribe, culturally had wide and various roots.

In the numerous vicissitudes and migrations of the tribe, in which they suffered severely from cholera and smallpox, settlements were formed in Kansas, Iowa and Oklahoma. The records show a close and prolonged association with the Sauk, and the incorporation of elements from Potawatomi and Winnebago. A tribe thus many times depleted and restocked, although strongly resistant to white culture, is scarcely likely to have escaped the cultural influence of the many and intimate relations with other tribes. Hence at the time information was collected by William Jones, any assumption of the archaic and original pattern of Fox culture had become hazardous.

GRASSLAND AND FORAGE CROPS IN THE UNITED STATES

INFORMATION with regard to forage crops, range management and the botanical aspects of soil conservation in the United States is either not available in published form or is scattered among a large number of reports. The Imperial Bureau of Pastures and Forage Crops at Aberystwyth has accordingly prepared a bulletin, compiled by R. O. Whyte, entitled "Research on Grassland, Forage Crops and the Conservation of Vegetation in the United States of America" (Herbage Publication Series, Bulletin 26. 5*s*.).

The bulletin deals first with the work of the Division of Forage Crops and Diseases, each of the five crop groups being studied from the point of view of culture and production, breeding and improvement, and diseases. An important recent development has been the organization of the U.S. Regional Research Laboratory, State College, Pennsylvania, which should become one of the leading world centres for the study of problems connected with humid temperate pastures. The range investigations of the Forest Service are then described. These are intended to supply basic information for the intelligent utilization of the land, the field work being organized into six regional forests and range experiment stations, covering the western United States. The research of the Soil Conservation Service deals with many aspects other than the use of grassland and forage crops as a protective cover for soil, and some account is given of the terms of reference of the eight branches of the Division of Research in the S.C.S., information not already published in Bulletin 25 being included.

Brief reference is made to the studies in progress under the auspices of the U.S. Golf Association, and details given of the ecological research at the Carnegie Institution of Washington regarding factor and function in adaptation, climax, succession and conservation.

The remainder of the bulletin contains relevant extracts from the most recent annual reports from practically all the agricultural experiment stations in the United States.

TRANSITION FROM CHARCOAL TO COKE IN IRON SMELTING IN BRITAIN

RATHER more than a year ago, the secretaries of the Royal Society of Arts discovered several bundles of old letters written to the Society between 1750 and 1800. The find is rich in information relating to the then manifold activities of the Society and to the inventors of those days. The careful study of the letters by appropriate experts may be expected to throw much light on an all too little known aspect of history, that of technical progress.

Unfortunately, the disturbed state of the world made it advisable to place the letters in safe keeping before the plans for their investigation could materialize. A beginning, however, had been made, and one letter by J. Wilkinson, probably the same Wilkinson who produced cannon during the Napoleonic wars, formed the *raison d'être* of a paper by Mr. H. Gwynn Jones on the charcoal iron industry, delivered before the Royal Society of Arts on November 15

Iron was at first smelted with charcoal by the direct process, wherein furnace and forge were under one roof. As the amount of charcoal within economic range became exhausted, the indirect method came into vogue in which pig iron was made in one locality and forged in another. The metal was run into a bed of sand furrowed herring-bone fashion, and when cool broken into the 'sow' or central furrow and the 'pigs' or offshoots.

The evidence afforded by the location of the early iron works, which demanded a supply of wood for charcoal, of iron ore, water transport and swift-flowing streams for power, gives an indication that the scarcity of charcoal was wide in its influence on the iron industry. The search for a substitute began before the eighteenth century; the first patent for coke was taken out in 1627, and apparently the Darbys of Coalbrookdale had established coke smelting of iron on a commercial scale by 1709, but it was thirty years or more later before a method of using coke in all the processes of smelting was discovered.

The long letter to the Society of Arts from Wilkinson written in 1761 makes it clear that at that date iron was produced mainly with charcoal. He suggests that the Society should consider how to make coke pig iron as good as that made with charcoal, next how to make tough bar iron from the coke pigs, and finally how to convert these into steel equal in goodness to that made from Swedish bar iron. He writes: "this Kingdom has materials enough to make all the iron that is consumed provided the coke scheme can be established in the making of pig iron equal in goodness to those made with charcoal".

His remarks, besides showing that the iron industry was tied to charcoal in 1761, foreshadow the changes which were to take place in the British iron industry when iron and coal were finally wedded, causing it to lead the world for at least a century.

As a result, the industry abandoned its scattered homes and became established in localities where coal and iron were found side by side; a wooded district with rapid streams was no longer necessary.

E. F. A.

TORSIONAL EFFECTS OF TORSIONAL OVERSTRAIN IN MILD STEEL

A PAPER by Prof. H. W. Swift on the torsional effects of torsional overstrain in mild steel, which had been prepared for presentation at the cancelled Cardiff Autumn Meeting of the Iron and Steel Institute, has been abridged and is published in *Engineering* of October 20. The usefulness of a material for manipulative processes in which severe plastic deformation is involved, depends primarily on the range of elastic flow to which it can safely be subjected. This depends in turn on, first, the stress-strain characteristics for the material within the elastic range; secondly, the stress-strain characteristics for the material within the plastic range; and thirdly the cohesive properties of the material which resist rupture.

The conditions of elastic breakdown have been the subject of much study and discussion. Some theories still have their champions, but most engineers regard maximum stress as the criterion of breakdown for brittle materials and shear strain energy (or shear-stress on the octahedral planes to which this is implicitly related) for ductile materials. In a ductile material it is generally thought that rupture occurs by shear. In a tensile stress the familiar cup and cone fracture indicates sliding at the instant of rupture, and in torsion the surface of rupture is a transverse plane of maximum shear stress. But it has been proved that the process of rupture at the neck of a ductile bar in tension always commences inside the material across what is substantially a plane of maximum tensile stress. Shear sliding on the cup and cone basis sometimes occurs to a measurable extent after fracture has been initiated.

Simple tension and simple shear are the two simplest methods of making exploratory tests. In addition, measurements of hardness are taken on the surface of tension of torsion bars at various stages of overstrain, and plotted in diagrams. Tables are shown of the principal test data relating to the tensile properties after torsional overstrain. It was found that after fracture had commenced (internally), which was proved by the sudden drop of the beam of the testing machine, a certain amount of drawing continued in the unbroken outer angular ring, and the diameter at the neck after complete separation was measurably less than that when the fracture commenced. It was found that neither strain energy nor hardness was a controlling factor in regard to rupture.

SCIENCE NEWS A CENTURY AGO

Lynch's Explorations in Mesopotamia

At a meeting of the Geographical Society on November 25, thanks to the president of the India Board, a communication was read from Lieutenant Henry Blosse Lynch (1807–73) of the Indian Navy relating to his survey of the River Tigris between Ctesiphon and Mósul. "Chains of triangles," said Lynch, "covered Nineveh to Baghdád, Baghdád to Babylon, Babylon to Ctesiphon, Ctesiphon to Baghdád, and the mountains of Hamrín in two points, namely, where the Tigris bursts through them in the N., and Wiyálah to the north-eastward; most of the principal points within the range of these are fixed either by an extension of the trigonometric chains, or by latitudes and true bearings checked by longitudes; the great canals also have been touched by our work sufficiently to show their direction and position. As we work, the field, instead of being diminished, appears to extend; and I have been obliged to leave with regret the tracing of the splendid canals and rivers, and the filling in of the villages and ruins, for more favourable times. . . ."

Anniversary Meeting of the Royal Society

In his address at the anniversary meeting of the Royal Society on November 30, 1839, the president, the Marquis of Northampton, said that "the past year has indeed been to that portion of the Royal Society which takes an active part in its affairs, one of more than usual labour and exertion—of labour and exertion, destined, as I hope, to produce rich and ample fruit. The great and marking peculiarity which has attended it, has been the sailing of the Antarctic Expedition. . . . The Expedition has now sailed, amply provided with the best scientific instruments and furnished with ample scientific instructions. . . . I have stated, Gentlemen, that your Council had recourse to the Scientific Committees for assistance in drawing up instructions for the Expedition in different branches of knowledge; those committees, who were named only two years ago, were at first apparently more a matter of form than substance; they have now been capable of doing excellent service".

The Royal Medals for 1839 were awarded to Dr. Martin Barry (1802–55) for his researches in embryology and to Sir James Ivory (1765–1842) for his investigations on astronomical refraction, while the Copley Medal was awarded to Robert Brown (1773–1858) for his "Discoveries during a Series of Years on the Subject of Vegetable Impregnation". Humboldt denominated Brown "botanicorum facili princeps". The son of a Scottish clergyman, Brown, after attending the Universities of Aberdeen and Edinburgh, was made an army surgeon. At the age of twenty-seven he became known to Sir Joseph Banks, through whom he was appointed naturalist to the expedition sent to Australia in 1801 under the command of Captain Matthew Flinders. When Brown returned to England four years later he brought back a collection of 4,000 plants. Soon after his return he was made librarian to Banks and in 1823 became possessed of both his library and herbarium. The collection of plants he offered to the British Museum, and in 1827 he became keeper of the botanical department in the Museum, a post he held until his death. He was admitted F.R.S. in 1811, in 1833 was elected a foreign associate of the Paris Academy of Sciences, and in 1849 was chosen president of the Linnean Society.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Temporary Assistant Librarian—The Registrar, University College, Southampton (December 6).

Nuffield Professor of Orthopædic Surgery—The Registrar, University Registry, Oxford (December 16).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Memoirs of the Royal Meteorological Society. Vol. 4, No. 40: Correlations between Monthly Rainfall at Eleven Stations in the British Isles. By D. A. Boyd. Pp. 143–160. (London: Royal Meteorological Society.) 2s. 6d. [3010

Institute of Metals. Industrial Applications of Spectrography in the Non-Ferrous Metals Industry. By F. Twyman. With a Report of a General Discussion on the Subject, held in London on March 9, 1939. (Reprinted from the *Journal of the Institute of Metals*, Vol. 64, No. 1, 1939.) Pp. 38+2 plates. (London: Institute of Metals.) 2s. 6d. net. [3010

Air Ministry: Meteorological Office. The Weekly Weather Report for the Period February 27th, 1938, to February 25th, 1939. Sixty-first Year, Vol. 55 (New Series): Particulars of Temperature, Rainfall and Bright Sunshine for each Week. (M.O. 439). Pp. 72. (London: H.M. Stationery Office.) 7s. 6d. net. [3010

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 30: Actiniaria and Zoantharia of the Scottish National Antarctic Expedition, 1902–1904. By Prof. Oskar Carlgren. Pp. 791–800. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1s. 3d. [111

Ministry of Health. Report on the Work of the Central Midwives Board for the Year ended 31st March 1939. Pp. 24. (London: H.M. Stationery Office.) 4d. net. [111

Vitamin E: a Symposium held under the auspices of the Food Group (Nutrition Panel) of the Society of Chemical Industry on Saturday, 22nd April, 1939, at the London School of Hygiene and Tropical Medicine. Pp. viii+88. (London: Society of Chemical Industry.) 5s. [311

London Shellac Research Bureau. Bulletin No. 5: The Hot Spraying of Shellac; a New Method of Coating Surfaces. Pp. 22. (London: London Shellac Research Bureau.) [911

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1939. (M.O. 438.) Pp. 52. (London: H.M. Stationery Office.) 9d. net. [911

Imperial Bureau of Dairy Science. Technical Communication No. 1: The Phosphatase Test for Control of Efficiency of Pasteurization. By H. D. Kay, R. Aschaffenburg and F. K. Neave. Pp. 56. (Shinfield, Reading: Imperial Bureau of Dairy Science.) 2s. [1011

Medical Research Council. Nineteenth Annual Report of the Industrial Health Research Board to 30th June 1939. Pp. iii+34. (London: H.M. Stationery Office.) 6d. net. [1311

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 11, No. 1, June 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+111. (London: H.M. Stationery Office.) 4s. 6d. net. [1311

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 3, No. 23: Genetic Algebras. By Dr. I. M. H. Etherington. Pp. 242–258. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1s. 6d. [1311

Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 4: The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children (Final Report); Summary of all Researches carried out by the Committee and Practical Conclusions. Pp. 70. (Shinfield, Reading: National Institute for Research in Dairying.) 2s. [1411

A Lecture on Magnesite. By A. W. Comber. (Twenty-second Streatfeild Memorial Lecture, 1939.) Pp. 26+4 plates. (London: Institute of Chemistry.) [1511

Lily Year-Book 1939. (No. 8.) Pp. iv+183+17 plates. (London: Royal Horticultural Society.) Paper, 5s.; cloth, 6s. [1611

Preliminary Report on the Problems of Evacuation. Pp. 32. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 1s. net. [1711

Other Countries

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology. No. 1: Items 4260–4378, January, February, March, 1939. By Ernest A. Hodgson. Pp. 22. (Ottawa: King's Printer.) 25 cents. [3010

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1933–34. English Version. Part 1. Pp. 178. (Cairo: Government Press.) P.T. 50. [111

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 182: Note on the Effect of Boundary Walls of a Stream upon the Circulation round a Plane Aerofoil. By Susumu Tomotika, Kō Tamada and Yukimasa Saitō. Pp. 363–394. 45 sen.

No. 183 : On the Deformation of Free Boundary due to Line Vortices. By Isao Imai. Pp. 395–438. 60 sen. (Tōkyō : Kōgyō Tosho Kabushiki Kaisha.) [111

Imperial College of Tropical Agriculture : Low Temperature Research Station. Memoir No. 11 : Metabolic and Storage Investigations on the Banana. By C. W. Wardlaw, E. R. Leonard and H. R. Barnell. Pp. iv+61+19 plates. 3s. 6d. net. Memoir No. 12 : Storage Investigations with Trinidad Grapefruit, 1938–39. By C. W. Wardlaw and E. R. Leonard. Pp. 20+3 plates. 2s. net. (Trinidad : Imperial College of Tropical Agriculture.) [111

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March, 1939. Pp. 8. (Salisbury : Queen Victoria Memorial.) [211

Bulletin of the American Museum of Natural History. Vol. 76, Art. 5 : The Mammals of the Guiana Region. By G. H. H. Tate. Pp. 151–230. Vol. 76, Art. 6 : Studies of Birds from Eastern Brazil and Paraguay, based on a Collection made by Emil Kaempfer. By Elsie M. B. Naumberg. Pp. 231–276. (New York : American Museum of Natural History.) [311

Reports of the Japan Institute for Science of Labour, Inc. No. 42 : Temperature and Humidity in various Workshops of the Textile Industry in Japan. By Dr. Sinzi Katuki and Dr. Hirosi Sukegawa. Pp. ii+23. 50 sen. No. 43 : Volksernährung in Japan. By Dr. Gito Teruoka. Pp. 14. 40 sen. (Tokyo : Japan Institute for Science of Labour, Inc.) [311

Bernice P. Bishop Museum. Bulletin 159 : Review of the Fauna of the Marquesas Islands and Discussion of its Origin. By A. M. Adamson. (Pacific Entomological Survey : Publication 10.) Pp. ii+93. (Honolulu : Bernice P. Bishop Museum.) [311

India Meteorological Department. Scientific Notes, Vol. 7, No. 81 : Vertical Currents in the First Few Kilometres over Poona and their Possible Effect on the Measures of Upper Winds made by Pilot Balloons assumed to rise at a Known Constant Rate. By K. P. Ramakrishnan. Pp. 233–242+5 plates. 9 annas ; 10d. Scientific Notes, Vol. 7, No. 82 : An Analysis of Indian Rainfalls using the Median as a Statistic. By L. S. Mahalingam. Pp. 243–254+4 plates. 12 annas ; 1s. (Delhi : Manager of Publications.) [611

Twenty-first Annual Report of the National Research Council of Canada, 1937–1938. Pp. 178. (Ottawa : National Research Council of Canada.) 75 cents. [611

U.S. Department of Agriculture : Weather Bureau. Monthly Weather Supplement No. 41 : Meteorological Results of the Byrd Antarctic Expeditions, 1928–30, 1933–35, Tables. By G. Grimminger and W. C. Haines. (W.B. No. 1270.) Pp. iv+377. (Washington, D.C. : Government Printing Office.) 1 dollar. [611

Bulletin of the American Museum of Natural History, Vol. 85 : The Birds of the Belgian Congo, Part 2. By James P. Chapin. Pp. vii+632+21 plates. (New York : American Museum of Natural History.) [611

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series, No. 22 : The Identification of Grubs from Rubber Estates. By G. H. Corbett and N. C. E. Miller. Pp. 7+4 plates. (Kuala Lumpur : Government Press.) 50 cents. [611

University of Toronto Studies. Mathematical Series, No. 7 : Some Integrals, Differential Equations, and Series related to the Modified Bessel Function of the First Kind. By Dr. A. H. Heatley. Pp. 32. (Toronto : University of Toronto Press ; London : Oxford University Press.) 4s. 6d. net. [711

Indian Central Cotton Committee : Technological Laboratory. Technological Bulletin, Series A, No. 49 : Technological Reports of Standard Indian Cottons, 1939. By Dr. Nazir Ahmad. Pp. iv+106. (Bombay : Indian Central Cotton Committee.) 1.8 rupees. [811

Bulletins of Indian Industrial Research. No. 15 : Recovery of Titanium Oxide as a By-Product in the Manufacture of Alumina-Ferric from Bauxite. By Sudhir Chandra Chakravarty. Pp. iv+10. (Delhi : Manager of Publications.) [811

Year-book of the Royal Asiatic Society of Bengal. Vol. 4, 1938. Pp. 138. (Calcutta : Royal Asiatic Society of Bengal.) 3.8 rupees. [811

Indian Science Abstracts (Being an Annotated Bibliography of Science in India). 1936, Part 2. Pp. 62+68+35–45. 8 rupees. 1937, Part 1. Pp. 18+38+46+64. 10 rupees. (Calcutta : National Institute of Sciences of India.) [811

Union of South Africa : Department of Mines, Geological Survey, Memoir No. 36 : The Mineral Deposits of the Murchison Range, East of Leydsdorp. By O. R. Van Eeden, F. C. Partridge, L. E. Kent and J. W. Brandt. Pp. 172+10 plates. (Pretoria : Government Printer.) 7s. 6d., including Map. [811

Ministry of Public Works, Egypt : Physical Department. The Nile Basin. By Dr. H. E. Hurst and the late Dr. P. Phillips. Second Supplement to Vol. 3 : Ten-day Mean and Monthly Mean Gauge Readings of the Nile and its Tributaries for the Years 1933–1937 and Normals for the Period 1912–1937. (Physical Department Paper No. 37.) Pp. 291. (Cairo : Government Press.) P.T. 50 ; 10s. [811

International Institute of Agriculture. Documentation for the European Conference on Rural Life, 1939. Pp. 370. (Rome : International Institute of Agriculture.) 25 lire. [811

Six Lectures on *Sinanthropus pekinensis* and Related Problems. By Prof. Franz Weidenreich. (Reprinted from the *Bulletin of the Geological Society of China*, Vol. 19, No. 1.) Pp. iv+110+9 plates. (Peiping : Peiping Union Medical College.) [911

Palaeontologia Sinica. New Series D, No. 7 (Whole Series No. 118) : Le rôle des animaux et des causes naturelles dans la cassure des os. Par Dr. Pei Wen-Chang. Pp. 64+21 plates. (Peiping : The French Bookstore.) [911

League of Nations : Economic Intelligence Service. Urban and Rural Housing. (II. Economic and Financial. 1939. II. A.2.) Pp. xxxvi+160. (Geneva : League of Nations ; London : George Allen and Unwin, Ltd.) 3s. 6d. [1011

South Australia. The Institute of Medical and Veterinary Science : First Annual Report of the Council, July 1938—June 1939. Pp. 16. (Adelaide : Institute of Medical and Veterinary Science.) [1311

Department of Agriculture, Straits Settlements and Federated Malay States. Economic Series No. 10 : Malayan Agricultural Statistics 1938. By D. H. Grist. Pp. xi+102 tables. 1 dollar. Annual Report on the Departments of Agriculture, Malaya, for the Year 1938. Pp. iv+92. 1 dollar. (Kuala Lumpur : Department of Agriculture.) [1311

Department of Public Instruction, Technical Education Branch : New South Wales. Technological Museum : Curator's Annual Report for Year ended 31st December 1938. Pp. 6. (Sydney : Government Printer.) [1311

Smithsonian Miscellaneous Collections. Vol. 98, No. 24 : The Ptarmigania Strata of the Northern Wasatch Mountains. By Charles Elmer Resser. (Publication 3550.) Pp. ii+72+14 plates. (Washington, D.C. : Smithsonian Institution.) [1411

Proceedings of the United States National Museum. Vol. 87, No. 3072 : A Study of Leconte's Types of the Beetles in the Genus *Monoxia*, with Descriptions of New Species. By Doris Holmes Blake. Pp. 145–172+plates 18–19. (Washington, D.C. : Government Printing Office.) [1411

Field Museum of Natural History. Botanical Series, Vol. 17, No. 6 : Genus Labordia, Hawaiian Euphorbiaceae, Labiatae and Compositae. By Earl Edward Sherff. Pp. 445–612. 1.25 dollars. Zoological Series, Vol. 24, No. 5 : Eight New Bats of the Genus Rhinolophus. By Colin Campbell Sanborn. Pp. 37–44. 10 cents. Zoological Series, Vol. 24, No. 6 : A New Coral Snake from British Guiana. By Karl P. Schmidt. Pp. 45–48. 10 cents. Zoological Series, Vol. 24, No. 7 : Reptiles and Amphibians from Southwestern Asia. By Karl P. Schmidt. Pp. 49–92. 30 cents. Zoological Series, Vol. 24, No. 8 : Malacological Notes. By Fritz Haas. Pp. 93–104. 15 cents. Zoological Series, Vol. 24, No. 9 : Carcinological Notes. By Claire Nemec. Pp. 105–108. 10 cents. Zoological Series, Vol. 24, No. 10 : Three New Birds of the Genus Stachyris. By H. G. Deignan. Pp. 109–114. 10 cents. (Chicago : Field Museum of Natural History.) [1411

Suomen Geodeettisen laitoksen julkaisuja (Veröffentlichungen des Finnischen Geodätischen Institutes). No. 28 : Verbesserung der horizontalen Winkelmessungen Wegen der Seitenrefraktion. Von T. J. Kukkamäki. Pp. 18. No. 29 : Ergebnisse der astronomischen Ortsbestimmungen im Jahre 1933. Von Ilmari Bonsdorff. Pp. 48. (Helsinki : Finnischen Geodätischen Institutes.) [1511

Publications of the Isostatic Institute of the International Association of Geodesy. No. 6 : On the Upheaval of Land in Fennoscandia. By Erkki Niskanen. Pp. 30+2 plates. (Helsinki : International Association of Geodesy.) [1511

Publications of the Astronomical Institute of the University of Amsterdam. No. 6 : A Photometric Study of some Stellar Spectra (δ Cephei, ν Cygni, π Cephei, δ Equulei). Part 1 : Catalogue of Line Intensities. By A. Pannekoek and G. B. Van Albada. Pp. iv+70. (Amsterdam : Stadsdrukkerij.) [1511

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 105, Nr. 4 : The Scoresby Sound Committee's Second East Greenland Expedition in 1932 to King Christian IXs Land. The British East Greenland Expedition 1935–36. Geological Investigations in East Greenland. Part 3 : The Petrology of the Skaergaard Intrusion, Kangerdlugssuaq, East Greenland. By L. R. Wager and W. A. Deer. Pp. 352+27 plates. (København : C. A. Reitzels Forlag.) 20.00 kr. [1611

Osiris, Vol. 6 : Societatum Eruditarum Concilio Americano Favente Iosepho Bidez Oblatum. Edited by George Sarton. Pp. x+844. (Bruges : Saint Catherine Press, Ltd.) [1611

Bulletin of the Buffalo Society of Natural Sciences. Vol. 19, No. 1 : The Butterflies of the Niagara Frontier Region and Beginner's Guide for Collecting, Bearing and Preserving Them. By William Wild. Pp. 55 (8 plates). (Buffalo, N.Y. : Buffalo Museum of Science Press.) 1 dollar. [1611

Supplement to Root Nodule Bacteria and Leguminous Plants. By Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy. Pp. 40. (Madison, Wis. : University of Wisconsin Press.) 50 cents. [1711

New Zealand : Department of Lands and Survey. Annual Report on Scenery Preservation for the Year ended 31st March 1939. Pp. 12. 6d. Annual Report on Public Domains and National Parks of New Zealand. Pp. 13. 6d. (Wellington : Government Printer.) [1711

Memoirs of the American Philosophical Society. Vol. 11 : The Composition of Ancient Greek Bronze Coins. By Prof. Earl Radcliffe Caley. Pp. viii+203+4 plates. (Philadelphia, Pa. : American Philosophical Society.) 2.50 dollars. [1711

Monografía de la Universidad de Puerto Rico. Serie B, Núm. 4 : Enfermedades de la plantas economicas de Las Antillas. Por Dr. Melville Thurston Cook. Traducido directamente del manuscrito original por José I. Otero. Pp. 530. (Puerto Rico : Universidad de Puerto Rico.) [1711

Agricultural Experiment Station : South Dakota State College of Agriculture and Mechanic Arts. Bulletin 311 : Alkali Disease or Selenium Poisoning. By Alvin L. Moxon. Pp. 91. Technical Bulletin No. 2 : Selenium in Rocks, Soils and Plants. By Alvin L. Moxon, Oscar E. Olson and Walter V. Searight. Pp. 94. (Brookings, S.D. : State College of Agriculture and Mechanic Arts.) [1711

Mémoires de la Société de Physique et d'Histoire naturelle de Genève. Vol. 42, Fasc. 1 : Magnitudes bolométriques, diamètres, masses et densités d'étoiles. Par Paul Rossier. Pp. 96. (Genève : Georg et Cie.) 8 francs. [1711

Catalogues

Royal Worcester Laboratory Porcelain. Pp. 8. (London : A. Gallenkamp and Co., Ltd.)

Books on Various Subjects. (Catalogue No. 641.) Pp. 54. (London : Francis Edwards, Ltd.)

Films about Oil : a Catalogue of 35mm. and 16mm. Films about the Oil Industry and the Uses of Oil which may be Borrowed Free. Pp. 20. (London : Petroleum Films Bureau.)

RECENT SCIENTIFIC AND TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Aitken, A. C. Determinants and Matrices. (University Mathematical Texts.) Cr. 8vo. Pp. vii + 136. (Edinburgh and London : Oliver and Boyd, 1939.) 4*s.* 6*d.* net.*

Albert, A. Adrian. Structure of Algebras. (American Mathematical Society, Colloquium Publications, Vol. 24.) Sup. Roy. 8vo. Pp. xi + 210. (New York : American Mathematical Society, 1939.) 4 dollars.*

Allanson, W. G. Junior Physics. Cr. 8vo. Pp. viii + 252. (London : Edward Arnold and Co., 1939.) 3*s.*

Allen, H. S., and **Maxwell, R. S.** A Text-Book of Heat. Part 2. Demy 8vo. Pp. xi + 531–849 + xi. (London : Macmillan and Co., Ltd., 1939.) 10*s.* 6*d.**

Barnard, S., and **Child, J. M.** Advanced Algebra. Demy 8vo. Pp. x + 280. (London : Macmillan and Co., Ltd., 1939.) 16*s.**

Baxter, H. A. Elementary Geometry. Cr. 8vo. Pp. vii + 215. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1939.) 4*s.*

Belinfante, Frederik Jozef. Theory of Heavy Quanta. Roy. 8vo. Pp. xii + 126. ('s-Gravenhage : Martinus Nijhoff, 1939.)*

Broglie, Louis de. Matter and Light : the New Physics. Translated by W. H. Johnston. Demy 8vo. Pp. 300. (London : George Allen and Unwin, Ltd., 1939.) 12*s.* 6*d.* net.*

Chalmers, Bruce. The Physical Examination of Metals. Vol. 1 : Optical Methods. Demy 8vo. Pp. viii + 181 + 4 plates. (London : Edward Arnold and Co., 1939.) 14*s.* net.*

Eddington, Sir Arthur. The Philosophy of Physical Science. (Tarner Lectures, 1938.) Demy 8vo. Pp. ix + 230. (Cambridge : At the University Press, 1939.) 8*s.* 6*d.* net.*

Gillespie, R. P. Integration. (University Mathematical Texts.) Cr. 8vo. Pp. viii + 126. (Edinburgh and London : Oliver and Boyd, 1939.) 4*s.* 6*d.* net.*

Ince, E. L. Integration of Ordinary Differential Equations. (University Mathematical Texts.) Cr. 8vo. Pp. viii + 148. (Edinburgh and London : Oliver and Boyd, 1939.) 4*s.* 6*d.* net.*

King, Horace Williams. Manning Formula Tables for Solving Hydraulic Problems. Vol. 2 : Flow in Open Channels. Med. 8vo. Pp. 379. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 30*s.*

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